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# CROP PRODUCTION RESEARCH

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1980  
ANNUAL  
REPORT

UNITED STATES  
DEPARTMENT OF  
AGRICULTURE

SCIENCE AND  
EDUCATION  
ADMINISTRATION

AGRICULTURAL  
RESEARCH

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## FOREWORD

### Crop Production

Research under Program Element 677, Crop Production Efficiency Research, includes research under 14 National Research Programs (NRP) in Crop Production and 1 Special Research Program (SRP).

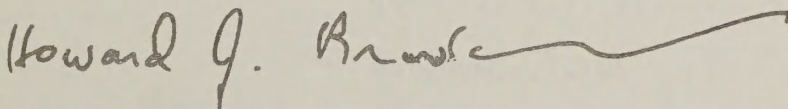
Research is conducted to improve plant productivity through improved varieties of food, feed, fiber, forage, florist and nursery crops, and turf; to develop new crop resources; and to develop improved crop production practices. Current emphasis is on research to develop new genetic stocks and varieties, increase yields and quality of crops, improve mechanization and crop production practices, and to alleviate the effects of adverse environmental conditions through hardier plants.

New multidisciplinary concepts for increasing our productive capacity have been initiated. Special emphasis has been placed on improving basic photosynthetic processes in plants, natural nitrogen-fixing processes in soils and plants, better use efficiency of both renewable and nonrenewable energy resources, and control of plant growth and development.

The research workers in the plant sciences publish the results of their investigations in the open literature as quickly as sound judgment warrants. This is an administrative report to provide for those interested in the results of this work a brief overview of the scope of the activities and examples of recent findings, some of which still have not been released by publication. No attempt is made at completeness.

This report outlines the research for which the Crop Production Staff is responsible and provides a brief description of recent accomplishments at the various locations throughout the United States. The report is organized by SEA National Research Programs, each of which describes a separate subject matter area. The SEA National Research Programs are subdivided into Technological Objectives which more specifically describe the objectives of each area of research.

Readers who have comments or inquiries are invited to contact either the National Program Staff or, more appropriately, scientists at the locations where the research is conducted.



HOWARD J. BROOKS  
Acting Chief  
Crop Production

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## SUMMARY

Crop production research is an integral part of the total research program conducted by Agricultural Research of the Science and Education Administration. Research is conducted to improve plant productivity through improved varieties of food, feed, fiber, forage, florist, and nursery crops; to develop new crop resources; to better understand biological processes; and to develop improved crop production practices. Current emphasis is on research to preserve germ-plasm resources, to develop new genetic stocks and varieties, increase yields and quality of crops, improve crop production practices, and to alleviate the effects of adverse environmental conditions. There also is a new awareness of the need and opportunity to better understand the basic physiology of growth. New technology and recent advances in the use of plant growth regulators have opened new vistas for the more perceptive scientists. Such research will be particularly important as plants are recognized for the potential they have as one of the few renewable resources available to man.

The research is described under 14 National Research Programs (NRP) and 1 Special Research Program (SRP).

A brief summary of each NRP and SRP is provided in the front of this volume. More detailed reports for each NRP and SRP follow with selected examples of progress and publications.

### NRP 20010 Breeding and Production - Fruits, Nuts, and Specialty Crops

The objectives of this National Research Program are to develop new improved varieties for fruits, nuts, and specialty crops and to develop new improved cultural and management practices for these crops. This research is presently being conducted at 16 locations by 63 scientists in several disciplines and serves many small and diverse horticultural industries. Research reported in this annual summary is also reported in 93 separate scientific articles. This current research includes highlights on (1) introduction of new improved pest-resistant varieties with increased consumer acceptance, (2) genetic studies on mode of inheritance of horticulturally important fruit and plant characteristics, (3) survey information on genetic resources available for use by those conducting breeding programs, (4) improved techniques for plant breeding, (5) cultural practices to increase yields and reduce cost of production, (6) improved methods of disease control, particularly viruses, (7) new rapid procedures for indexing plant material for viruses and virus-like disorders, and (8) physiology studies on plant growth, flowering, and fruiting.

### NRP 20020 Breeding and Production - Vegetables

This program emphasizes research in breeding and production of vegetables to develop new and improved genetic and cultural methods that will result in lowering costs of vegetables and potatoes to consumers and increasing efficiency of production of these crops to growers, small acreage farmers, and homeowners. Geneticists, plant pathologists, plant physiologists, and horticulturists (both Federal and State) work in a team approach to evaluate and improve vegetables and vegetable cultural methods.



Basic studies on heritability have led to the development of 32 new germplasm or breeding lines that include the theory of an endosperm balance number that enables potato and other crop breeders to make interspecific crosses between plants of different species but with the same endosperm balance number. Use of this system should enable potato breeders to increase frost and disease resistance into tuber-bearing breeding lines. Germplasm releases in several crops will provide new opportunities for cantaloupe with resistance to watermelon mosaic and other leaf fungus diseases, processing tomatoes with early maturity and good harvesting characteristics, bean cultivars resistant to peanut stunt virus and pea seedborne mosaic, improved earworm resistance in sweet corn, pickleworm resistance in cucumbers, root-knot resistance in snap beans, Cercospora resistance in southern pea, potato cultivars resistant to bacterial wilt, and multiple disease resistance in subtropical type dry beans.

Eighteen new cultivars were released, all with multiple disease resistance, that are expected to contribute significantly to improved vegetable production in various parts of the country. Recently released potato cultivars for Alaska, Maine, and the Northeastern States continue to increase in popularity for processing and fresh market use. A new cos lettuce is adapted for culture in the desert Southwest. A hybrid lima bean, Jackson Wonder type, has increased yields in Delaware, and a disease resistant polebean called Foot-long is adapted to southern culture. A new hybrid onion, Spartan Banner 80, can be grown where pink-rot resistance is important. Red Chief, a new red cotyledon lentil, will provide the first red lentil for the Palouse region of the Pacific Northwest. Several dry beans were released for production in the Pacific Northwest and tropical areas. These include navy, pinto, red Mexican, and other color types.

Research on improving cultural practices has shown that fall application of broad-spectrum soil fumigation controls many soilborne pests of vegetable transplants and also improves plant vigor, growth uniformity, and increases marketable transplant yields. A technique that combines soil and plant inoculation has made possible testing for bacterial wilt resistance for potatoes. Bacterial wilt is a major soilborne disease of many crops in tropical, subtropical, and mild temperate humid regions of the world.

#### NRP 20030 Breeding and Production - Florist and Nursery Crops

The major emphasis of this program deals with the multidisciplinary research to develop new technology for improving productivity and increasing efficiency in the production of florist and nursery crops to enhance urban and rural environments. This need for new knowledge makes it essential to provide research results on selecting, improving, protecting, maintaining, and cultivating plants for urban and rural home, landscape, and special purpose plantings such as parks, roadside, and shopping centers. Progress for this year included the release of three blackspot resistant roses—a pink, a gold, and a yellow flowered. These should find wide acceptance in the florist trade as there have been very few blackspot resistant cultivars heretofore. A new Dianthus cultivar called Smokey will increase the low temperature hardiness and disease resistance in this species. Cardan, a new green ash, was developed for use in windbreaks, wildlife habitat, and strip mine reclamation. Three other cultivars have been introduced to nurserymen

to determine their eventual usefulness in landscaping. One is a viburnum with large white inflorescences and scarlet fruit in late July - August. The other two are mildew resistant crape myrtles, a white flowered shrub named Muskogee and a light lavender flowered shrub named Natchez.

Another phase of the research deals with improved cultural and management practices that increase yield, minimize losses, and improve quality. The development of a total protection and even eradication procedure for powdery mildew of roses in commercial greenhouses by volatilizing fungicides offers real hope for control in the future. Three SEA/AR scientists were issued a Public Law patent for stable food and beverage color additive extracted from natural pigment in the 'Heavenly Blue' morning glory flower. It could be a useful replacement for banned red dyes.

Basic research on rhododendron has shown that weevil feeding preference is associated with extractable attractants in susceptible species and extractable inhibitors in resistant species. This knowledge is important in developing pest control strategies. Dutch-elm-disease fungus strains tolerant to benzi-midazales have been identified. Should such strains become widespread, new control measures will be needed. It was also demonstrated that ethylene is evolved by a host plant within hours after penetration of a fungal pathogen. The lack of feedback mechanism to shut off photosynthesis in plants forced to accumulate high starch was demonstrated for some nursery plants.

#### NRP 20040 Breeding and Production - Corn, Sorghum, and Millets

Corn inbred lines released by the cooperative USDA-State programs are widely used in commercial corn hybrids. The inbreds B73 and M017 were utilized in commercial corn hybrids estimated to have been planted on 7.3 to 8.1 million hectares in 1978 with the main concentration being in the irrigated areas of the Great Plains and the central Corn Belt. There was probably little change in use of those inbred lines in 1979.

Long-term recurrent selection programs with maize are being conducted on several populations of normal corn and in two populations involving yield and protein content and quality. The impact of breeding populations on commercial breeding programs is not known, but the requests for seed allotments indicate commercial breeders are aware of their possible potential for line development.

Work to broaden the genetic base for maize breeding continues at a number of locations. This cooperative effort is concentrating on screening exotic races for pest resistance and general agronomic traits of interest in the breeding programs. Six of these racial collections have been chosen for use in population improvement programs for the future.

Four new corn inbred lines and five new corn germplasm populations were released in 1979 for use by public agency and private industry breeders or other research workers. This new germplasm makes available increased resistance to diseases and insects, improvements in grain quality, and advance in yield capacity.



#### NRP 20050    Breeding and Production - Small Grains

Primary emphasis is placed on basic and applied research directed toward improvement of varieties of wheat, oats, barley, and rice so that new varieties will produce more grain per acre, will have more effective protection from diseases and insects, will be able to withstand environmental adversities, and will produce better quality and more nutritious grain for food and feed.

In 1979, wheat was harvested from 62,600,000 acres, oats from 9,831,000 acres, barley from 7,468,000 acres, and rice from 2,979,000 acres in the U.S. Rye was harvested from an additional 940,000 acres and very small acreages of triticale, wild rice, and buckwheat were produced. All are included in NRP 20050.

During 1979, one wheat, two barley, and four rice varieties were released cooperatively by SEA/AR and State Agricultural Experiment Stations. In addition, 22 wheat and 14 barley germplasm populations or lines were released for use by breeders.

Research is conducted at 27 locations across the U.S. and involves 63 scientists. Most research is conducted in the North Central and the Western Regions, where most of the small grains are produced.

#### NRP 20060    Breeding and Production - Cotton

The mission is to develop new knowledge which will increase production efficiency and provide consumers with a stable supply of fiber and food at a reasonable cost. Research approaches emphasize genetic improvement and the development of more efficient cultural and management practices. The research is conducted at 14 locations and involves about 50 scientists.

Genetic research includes special emphasis on developing germplasm with resistance to insects, nematodes and diseases. Traits under investigation which reduce losses to insects include nectariless, high terpenoids in flower buds, high tannins in vegetative parts, pubescence, and early maturity. Germplasm has been identified which reduces egg production of root-knot nematodes to approximately 1%-2% of that observed on currently grown varieties. Genes and cytoplasm necessary for hybrid cotton production have been incorporated into Pima cotton. Two early maturing, short statured Pima strains which may be suitable parents for use in interspecific hybrid cotton have been released and distributed. A publication entitled "The Natural History of the Cotton Tribe" records the current state of knowledge of the taxonomy and evolution of cotton.

Shorter season cotton production systems are being investigated which significantly reduce the number of pesticide applications needed to control late season insects and which reduce overwintering insect populations. In addition, a shorter season system may reduce water and fertilizer use and make it possible to conserve energy with once-over harvest.

A bacterium with a broad potential for the biological control of seedling diseases has been isolated. This bacterium strongly inhibits the growth of most soil-borne fungal pathogens that attack cotton.

#### NRP 20080 Breeding and Production - Soybeans, Peanuts, and Other Oilseed Crops

Primary emphasis is placed on the improvement of soybean, peanut, sunflower, flax, safflower, and guar by genetics and breeding and by cultural and management practices. Approximately 31, 8, 6, and 6 SY's are assigned to soybean, peanut, sunflower, and other oilseeds, respectively. Soybean, peanut, sunflower, and other oilseeds production research is conducted at 11, 3, 4, and 5 locations, respectively; the total number of locations for oilseeds production research is 16. Most of the research is highly cooperative with State agricultural experiment stations and utilizes the disciplines of plant genetics, agronomy, plant pathology, plant physiology, microbiology, chemistry, entomology, and soil science.

The highlights of 1979 included: (1) cooperative releases of 10 soybeans improved for such characteristics as disease resistance, resistance to the herbicide metribuzin, semideterminate or determinate habit of growth for high yielding environments, and high yields and lodging resistance; (2) cooperative releases of an improved Spanish type peanut, two peanut germplasms resistant to *Cylindrocladium* black rot or *Cercospora* early leaf spot, and five guar lines with bacterial blight resistance, high test weight, and high yields; (3) expansion of the national soybean germplasm collection and evaluation program; (4) confirmation that breeding methodology is making genetic advances concurrently for high yield and protein and also for reduced linolenic acid; (5) confirmation that new soybean varieties are 25 percent higher in yield than old varieties, and that two genes for resistance to phytophthora root rot do not decrease yield in absence of the disease; (6) discovery of one line of soybean immune to Bean Pod Mottle Virus; (7) further progress in the development of peanuts resistant to *Aspergillus flavus*; (8) identification of sunflowers with resistances to charcoal rot, sclerotinia stalk rot, alternaria and *Rhizobus* head rot; and (9) increase of oil content of flax seed from 40 to as high as 45 percent by the plant growth regulator chlorflurenol, a morphactin.

#### NRP 20090 Breeding and Production - Sugar Crops

Primary emphasis in the program is on improvement of sugar crops through breeding of superior varieties, hybrids, and breeding lines. Secondary emphasis is on developing cultural and management practices to increase sugar and sirup yields, minimize production losses, improve quality attributes, and efficiently conserve scarce resources in production systems involving the three crops. This research is conducted at 10 locations by 38 scientists. Sugarcane is grown on about 300,000 hectares in 4 States, and sugarbeets are grown on 486,000 hectares in 16 States. During the period 1970-78, domestic production provided an average of 58 percent of U.S. sucrose consumption. The remainder was imported from several foreign sugarcane producing countries. Sweet sorghum is grown for sirup production in several southeastern States and has potential for sugar production, but current world overproduction and subsequent low sugar prices have precluded its use.

The highlights of the 1979 research include: the identification of cross-pollinated heterozygous sugarbeets resistant to nematodes and the development of the first rhizoctonia resistant monogerm sugarbeet with male sterility.



Breeding lines of sugarbeets were found that should be able to provide soil-free tap roots. Basic genetic studies have revealed that hybrid vigor is the result of an increased cell division rate rather than increased cell size and given new insights to the relationships among yellowing viruses.

Sugarcane breeding research has led to the release of an apparently smut resistant sugarcane variety for Florida. The long range variety development program for Louisiana, over a period of 55 years, has gradually raised the average sugar content of test varieties from 7 to 13 percent. The use of gibberellic acid on 4,000 hectares of sugarcane in Hawaii resulted in a gain of 1.4 tons sugar per hectare. At Meridian, Mississippi, considerable progress has been made toward improvement of the World Collection of Sweet Sorghum through seed increase, recovery of viable seed from old seed, and collection of needed descriptor data. Five sugarbeet breeding lines were released and one new cultivar each for sugarbeets, sugarcane, and sweet sorghum.

NRP 20100 Breeding and Production - Forage Crops for Hay, Pastures and Other Uses, Including Turf

Forage crops are gaining in attention because of the role they can play in reducing the need for nitrogen fertilizer, reducing the demand for grains in the production of quality beef and dairy products, and their contribution to reducing soil erosion and enhancing the Nation's water supplies.

The program is directed to improving the forage plants through basic genetics, plant breeding, plant physiology, and management. Research efforts are multidisciplinary, and scientists interact among Federal and State scientists to assure effective coordination of a national program on forage improvement and utilization.

NRP 20110 Improved Vegetation and Management Practices for Range

Range research has been receiving considerable attention in the past few years. Major emphasis is being placed on the multiple use aspects of range which results in new problems for AR scientists. Thus, the SEA-AR national research effort is directed toward improving the livestock production capacity of the range while maintaining and enhancing environmental quality and complementing other uses. Research ranges from basic cytogenetics through development of integrated range management systems. Improvement of introduced and native species and development of range improvement practices receive major attention and provide technology for responding to environmental questions and for use by public and private rangeland managers.

NRP 20160 Introduction, Classification, Maintenance, Evaluation, and Documentation of Plant Germplasm

This is a three-pronged program: plant germplasm, new crops, and control of narcotics crops. The grouping is a natural one; all three programs draw heavily upon the botanical disciplines of taxonomy, ecology, and plant geography because they all deal with the occurrence and distribution of diversity among plants on a systematic, ecological, and geographical basis. The plants under study are mostly noncultivated or are being evaluated for their potential of useful diversity to established crops.

People that several years ago did not know what germplasm was, or did not care, are, across the land in universities, professional societies, back-to-nature movements, and in Congress, speaking out in concerned tones that this renewable, but irreplaceable, resource be given the national priority that it merits. The Director, Science and Education Administration, was apprised of the National Plant Germplasm System's needs and commissioned a review of it for the purpose of defining its strengths and weaknesses in organization, management, policy development and implementation, planning functions, and utilization of resources. The study will be completed by September 1, 1980.

Studies are under way to determine opportunities and methods for manipulating the biosynthesis mechanisms in narcotic plants leading to the elaboration of morphine and other phenanthrine alkaloids, cannabinoids, and cocaine. Through bioinduction these biosynthetic processes may be blocked or altered without killing the target plants or having adverse impact on other elements of the environment where such illicit crops are being produced.

The research under this NRP is being conducted at 27 locations in the U.S. and abroad, involves about 55 SY's, and is supported by approximately \$8.0 million.

#### NRP 20170    Physiological and Biochemical Technology to Improve Crop Production

This National Research Program coordinates and manages research elucidating the basic function of plants at the physiological and biochemical level. New data resulting from this research are used to establish advanced agricultural technology with emphases on field and horticultural crops.

Major fields of consequence within this National Research Program are: (1) improvement of photosynthetic capability, photosynthetic efficiency, translocation, metabolism, and biological conversion of solar energy of plants; (2) development of improved efficiency of nitrogen fixation and the absorption, translocation, and utilization of nutrients; (3) improvement of crop production under environmental stress and reduction of stress damage to plants; and (4) improvement of technologies for understanding water relations, seed germination, growth regulation, flowering, fruiting, and photoperiod as a base for using molecular biology to increase crop production efficiency.

There are 15 locations represented by 58.7 SY's engaged in research under this National Research Program. Research teams comprised of not only these scientists and their colleagues but expertise crossing many and varied National Research Programs work in concert, focusing on the optimal transfer of basic information to field application.

#### NRP 20180    Crop Pollination and Honey Production

Best available estimates indicate that there are in the United States about -- 200,000 beekeepers, owning 1-25 colonies of honey bees -- 10,000 beekeepers owning 25-299 colonies of honey bees -- 1,600 beekeepers owning 300 to 30,000 colonies of honey bees.

In total, there are 4,300,000 colonies kept by beekeepers and many thousands escaped swarms in hollow trees, the walls of houses, caves, etc. There are



also about 3,000 species and subspecies of wild (non-Apis) bees, mostly solitary rather than social, with three species--the alfalfa leafcutter, Megachile rotundata; the alkali bee, Nomia melanderi; and the orchard bee, Osmia lignaria--under man's control for crop pollination purposes. This constitutes the inventory of bees upon which the pollination of \$12-15 billion worth of crops depends for full economic yield and quality. Without this pollination resource we would lose our ability to produce many seed and fruit crops, and diversity of food would be drastically reduced. We would also lose many wild flowering plants and live in a markedly different world. In our changing environment we cannot be assured of adequate survival of wild bees or the profitability of beekeeping as an industry. If beekeeping were not profitable, it would largely cease to exist. Problems such as inadequate pasture, pesticide losses, and diseases confront the long-range survival of bees and beekeeping adequate for pollination requirements.

Research needs include all those associated with major livestock industries plus taxonomic, biological, and management studies of wild bees. The basic mission of this national research program is to help ensure the survival of plant pollinators. Projects encompass such diverse areas as apiary management; bee nutrition, particularly the development of pollen substitutes, control of bee diseases, pests, and parasites; easing the persistent and often serious problems of pesticide poisoning; the efficient use of bees for crop pollination; basic bee biology; the taxonomy, biology, usefulness, and management of wild bees; the genetic improvement of honey bees, including Africanized bees and studies of apiary products, particularly honey.

NRP 20190    Improved Methods and Equipment for Production of Field, Horticultural, and Fiber Crops

Equipment and methods are under development aimed at solving long-standing and difficult problems in the culture, harvesting, and farm handling of a variety of horticultural and field crops. Greatest emphasis continues to be on new or improved mechanisms which reduce the cost of production through reducing labor requirements, reducing the cost of machinery, or reducing crop losses. This development work also frequently requires research on the physical properties of plants and plant materials, and on plant cultural practices. Engineers work in cooperation with plant breeders, plant physiologists, plant pathologists, and specialists in food processing and marketing to plan as well as to execute this work. The research is conducted at 19 locations in 15 States in both Federal and State stations where work is usually done through an interdisciplinary team.

Substantial progress was made this year in reducing labor requirements for harvest of citrus, peaches, cherries, apples, peppers, lettuce, leafy vegetables, and peanuts. Further progress was made toward reducing machine costs for cotton and nursery crops. Other work indicates possible methods of saving energy through reducing tillage operations, improved straw disposal methods, and more efficient dryer operation.

Progress in developing less costly ways of handling apples continued at projects in both Midwest and Pacific Northwest locations. Substantial information was also collected on the most effective sources of light required for supplemental greenhouse lighting for a number of species.

Increased emphasis in this work is now being given to reduction of fossil fuel use and production equipment which is most compatible with conservation tillage practices.





## National Research Program 20010

### BREEDING AND PRODUCTION - FRUITS, NUTS, AND SPECIALTY CROPS

This National Research Program involves research on breeding and production of fruits, nuts, and specialty crops which will result in increased production efficiency for commercial growers, part-time farmers, and homeowners and increased availability, variety, and quality of fruits and nuts for consumers. Where possible, this research is conducted by multidisciplinary teams comprised of horticulturists, geneticists, physiologists, and pathologists and in association with entomologists, nematologists, agricultural engineers, and marketing specialists. The research is national or regional in scope and concentrates on long-range projects not easily initiated or justified by individual State Agricultural Stations.

Technological Objective 1: Develop new and improved varieties of fruits, nuts, and specialty crops that combine improved yield potentials; quality characteristics; better resistance to pests; tolerance to environmental stress; and adaptation for mechanical culture, harvesting, and handling.

NPS Contact: Howard J. Brooks

#### Research Locations:

Fresno, California  
Indio, California  
Orlando, Florida  
Byron, Georgia  
Beltsville, Maryland  
Poplarville, Mississippi  
Chatsworth, New Jersey  
Wooster, Ohio  
Corvallis, Oregon  
Brownwood, Texas

#### Examples of Recent Progress:

Progress made in breeding improved grape varieties - Fresno, California. Approximately 11,600 grape hybrid seedlings from 61 controlled crosses were planted in the field along with 3,000 seedlings from 20 crosses for a seedless inheritance study. This year 148,600 emasculations resulted in 16,800 seeds from 75 controlled crosses. This resulted in 7,500 seedlings which will be planted in the field in the spring of 1980. Sixty-eight new selections were made. Most were kept as potential early-ripening parents. Thirteen selections were propagated for the second

test plot. Four selections are being placed in grower trials. Thirty-six raisin selections were dried. One new selection was kept and four other selections appear promising. In the rootstock trial at the University of California Kearney Horticultural Field Station, the new Fiesta variety continued to yield as well as Thompson Seedless.

New table grape proving a commercial success - Fresno, California.  
The Flame Seedless table grape variety released in 1973 is in great demand. It is an early maturing, red seedless grape that is very crisp and flavorful. Approximately 90,000 twenty-three pound lugs were harvested from 250 bearing acres in 1979. Flame Seedless was receiving a premium of \$1.00 to \$2.00 per lug over other varieties. The non-bearing acreage is estimated to be between 1,000 and 2,000 acres. The rate of acreage increase is limited by the amount of rootings available.

Grape rootstocks screened for nematode resistance - Fresno, California.  
About 8,000 seedlings from 200 rootstock crosses were screened in the greenhouse for resistance to Meloidogyne incognita, M. javanica, and M. arenaria nematodes. The symptomless plants were rescreened in the field. Ten resistant plants from each cross were saved to be re-screened next year. The phylloxera test gave poor results and greenhouse techniques are being developed for better assessment. These screening programs will identify parents which will be later used to develop improved rootstocks.

Selections made in stone fruit breeding program - Fresno, California.  
About 24 plum, 25 apricot, and 133 peach and nectarine controlled crosses were made resulting in 4,800 plum, 1,600 apricot, 6,100 peach and nectarine seed which were planted in the greenhouse during November 1979. An additional 2,000 plum and 6,500 peach and nectarine embryos were cultured on nutrient media in test tubes from which 1,100 plums and 4,100 peach and nectarine plants were grown and transplanted to soil. Of the fruiting progenies, 104 peach, 58 nectarine, 35 apricot, and 2 plum seedlings were selected and saved for further evaluation. Nine peach, 7 nectarine, 6 plum, and 2 apricot selections are being tested commercially and appear promising as potential varieties. One plum selection, K68-43, was named Blackamber and released for commercial production in 1980.

Nematode-resistant peach rootstock introduced - Fresno, California.  
One redleaf nematode-resistant peach rootstock, P115-95, was released to nurserymen in 1980 and will be named in 2 years if it continues to look promising. A long-term test including P115-95 with 13 cultivars of peach, nectarine, plum, apricot, and almond was established this year to determine long-term benefits of the new redleaf rootstock.

Embryo culture techniques show promise - Fresno, California. A preliminary test to grow 1-5 mm long peach embryos was successful. Additional tests will be developed to determine best media and procedures to grow this size embryo to mature plants. Preliminary grape embryo culture experiments have yielded similar promising results. Embryos from one seedless selection with a large seed trace produced viable plants. These will be planted in the field in 1980.

Citrus breeding research to be terminated - Indio, California. After nearly 30 years, the citrus breeding program is scheduled for termination in 1982. More than 160 varieties and selections have been repropagated so as to maintain germplasm valuable for desert areas. This germplasm is being used as parents by the SEA-AR scientists at Orlando, FL. Studies continue on fruit quality of various scion varieties propagated on about 50 selected rootstocks.

Intergeneric hybridization used to develop new citrus varieties - Orlando, Florida. Research continues to develop improved varieties with resistance to cold, burrowing and citrus nematodes, Phytophthora, and tristeza virus. This year's breeding efforts yielded 2,382 seeds from inter-specific and intergeneric crosses designed to incorporate horticultural traits. Nine hybrid selections derived from crosses of Poncirus trifoliata and Citrus were made for further evaluation as potential size-controlling rootstocks and for further breeding. Eight selections were made for preliminary rootstock tests. In a preliminary test, 155 clones were evaluated for Phytophthora parasitica resistance, and 91 clones were evaluated in an advanced test.

Breakthrough made in developing cold-hardy citrus - Orlando, Florida. In an effort to broaden the genetic base of citrus varieties, geneticists have crossed grapefruit with the inedible Poncirus trifoliata and made back-crosses between the resulting F<sub>1</sub> hybrids and a low-acid sweet orange. New F<sub>2</sub> hybrids have been selected which look like a sweet orange; are edible; have soluble solids, acids, and other quality characteristics similar to commercial sweet oranges; and the trees appear to be more cold-hardy than sweet orange. This represents a new breakthrough in genetic engineering of citrus by providing edible citrus varieties with one-fourth of the genetic base derived from cold hardy but inedible Poncirus trifoliata.

Breeding deciduous citrus varieties is new research objective - Orlando, Florida. A new project has been initiated to determine if the deciduous characteristics of Poncirus trifoliata can be transferred to Citrus. A total of 948 seeds was derived from modified sib crosses of intergeneric hybrids involving various genetic combinations of three Citrus species and Poncirus. Such a characteristic might allow citrus to be grown in colder climates.



Field tests made of experimental rootstock hybrids - Orlando, Florida. A rootstock test for blight tolerance (30 rootstocks with five 8-tree replications each) was planted in February 1979 in a commercial grove in Indiantown. Observation in September showed that most rootstocks grew well. The exception was Citrus hystrix; many trees on this rootstock died within the first months in the field. A second test area for rootstocks was developed at Dundee, FL, where an experimental planting of six rootstocks was made.

Peach and nectarine selections made for the Southeastern States - Byron, Georgia. Thirteen advanced peach selections were propagated and distributed to other stations and 23 new seedlings were saved for further tests. Thirteen nectarine selections were also evaluated in a second test orchard. A total of 189 seedlings were saved for further evaluations. Twelve parental combinations of nectarine x nectarine and 4 nectarine x peach were used in approximately 13,000 pollinations. Forty seven selections from other breeding programs were planted for evaluation under southeastern conditions.

Progress made to develop plans for the Southeastern States - Byron, Georgia. The 1979 hybridization program in diploid plums stressed intercrossing, selfing (where possible), and outcrossing the 5 best seedling selections from 1968 and 1969 which have now been adequately tested. Primary selection for strong trees, disease resistance, and fruit appearance and quality was made in the seedling groups dating from 1974 to 1976 with 8 selections being made. Testing of older selections and named varieties continues with many being eliminated because of infections with bacterial spot (Xanthomonas pruni), bacterial canker (Pseudomonas syringae), and scorch (putative phony peach symptoms expressed on plums).

Pecan selections evaluated for the Southeastern States - Byron, Georgia. One hundred ten advanced pecan selections were compared among themselves and with 30 named selections for adaptability to the Southeastern United States. They were evaluated with regard to phenology, yield, nut quality, and disease resistance. After 3 years of screening, it is now possible to identify several selections and cultivars that are not suitable for high-density plantings in the southeastern environment. Yield and nut quality data from certain advanced selections and cultivars grown under irrigation at Albany, GA, were evaluated and suitable genotypes were identified for high-density intensive management.

New disease-resistant strawberry variety jointly introduced with the University of Maryland - Beltsville, Maryland. The new Scott strawberry was released to nurserymen for propagation and commercial introduction during 1980. Scott is the latest in a series of red stele and verticillium wilt resistant strawberries developed through this joint project. Scott ripens in late midseason; bears large, firm fruit; produces abundant fruit and runners; is widely adapted; and can be consumed either fresh or processed. Eighteen cross pollinations made for red stele



resistant cultivar development produced 34,400 seeds. Over 6,200 red stele resistant seedlings were planted at Wye, MD, of which 1,200 represented a replicated inbred, recombination study. On the average, inbred resistant selections, selfed, intercrossed, or outcrossed, transmitted red stele resistance to 70 percent of their seedling progenies. Intercrossing or outcrossing inbred selections restored vigor lost by inbreeding.

Four new strawberry cultivars jointly introduced with the North Carolina Agricultural Research Service - Raleigh, North Carolina. Four new strawberry cultivars were released in 1980 for propagation and introduction to the Southern United States. These were joint introductions with the North Carolina Agricultural Research Service. The four are Prelude, a fine quality, large, and attractive very early maturing berry for the Coastal Plain; Sumner, a vigorous, high yielding, broadly adapted midseason cultivar; Sentinel, a late maturing, very large, firm, high quality berry for all geographic areas of the Southeastern United States; and Rosanne, a very late maturing, high yielding, high quality cultivar with broad adaptation. Rosanne is the most consistently field resistant cultivar to anthracnose in North Carolina. Breeding for resistance to anthracnose is the major thrust for new seedlings and selections established at the North Carolina Agricultural Experiment Station.

New blackberry selections made in cooperative program with Ohio State University - Beltsville, Maryland. Blackberry cultivars and selections were evaluated at Ripley and Wooster, OH, and Beltsville, MD, for plant vigor, hardiness, susceptibility to cane blight, and fruit characters. Selections C33, C48, C58, C61, and C62 look promising both at Wooster and at Beltsville. Two new selections were made at Wooster this year and two of the older selections were repropagated. Approximately 80 new seedlings were sent to Wooster following screening to secure the thornless character. A new selection planting was established at Beltsville which included a replicated trial of the 4 named tetraploid thornless cultivars and 2 promising selections, and an unreplicated trial of 22 parental breeding selections. The propagation of thornless blackberries by rooting one node stem cutting is being applied commercially.

Disease immunity obtained in grape breeding program - Beltsville, Maryland. Over 4,600 grape seed were produced from 20 crosses. Following 2 black rot inoculations, 38 percent of 1,661 seedlings were retained. Of these (Vitis rupestris x V. vinifera) x American grape crosses yielded 40-60 percent immune seedlings; BC<sub>1</sub> crosses of (rupestris x vinifera) x vinifera yielded 10 percent, while BC<sub>1</sub> crosses of (cinerea x vinifera) x vinifera yielded 20 percent immune seedlings.

Blueberry clones selected for the Gulf States - Poplarville, Mississippi. Approximately 4,000 blueberry seedlings were planted in the spring of 1979. Adapted superior tetraploid and hexaploid selections and

established varieties were crossed. Seeds from these crosses were germinated for field planting in 1980. Twenty-one plants were selected for further evaluation from the 1977 blueberry seedling nursery. Criteria for selection included fruit size, color, taste, firmness, ripening date, yield, and plant growth. Three plants from the wild were selected for use as late ripening, disease resistant parents. Selections made prior to 1977 were evaluated for fruiting and other horticultural qualities.

Progress made in cooperative blueberry breeding program for the Gulf States - Poplarville, Mississippi. Cooperative research has been initiated with the University of Florida, North Carolina State University, Louisiana State University, and the University of Arkansas to find strawberry seedlings which exhibit resistance to crown rot and anthracnose. Seed from Beltsville, MD, crosses were germinated at Poplarville and 25,000 seedlings were grown in the greenhouse under controlled conditions. These seedlings were inoculated with 5 strains of *C. fragariae* and screened for anthracnose resistance. Resistant seedlings were shipped to cooperators. Twenty-four seedlings from the 1976 strawberry seedling field at Poplarville were selected for further evaluation. The selections were based on their high resistance to anthracnose, fruit flavor, size, color, firmness, yield, plant growth habit, and vigor.

Progress made in developing disease resistant pear varieties, Wooster, Ohio. Fourteen pear selections for good size and quality were made and propagated from the 1968 seedlings at Wooster. Five selections for good quality and size were made for 1969 seedlings. Severe infestation of pear psylla in the Beltsville plantings caused defoliation of most trees in early to mid-August. The lack of a dormant oil spray and very poor summer control of psylla were the contributing causes. Fruit harvested at Beltsville were generally of poor quality as a result of the defoliation. Several seedlings stood out as resistant to the pear psylla. A total of 841 seedlings and 86 cultivar fruit evaluations were made. At Beltsville, 66,839 blossoms were emasculated and pollinated and about 10,000 seeds were obtained. At Wooster, 5,557 pollinations were made. Fire blight continued to show up in the Wooster plantings while at Beltsville fire blight was static and light. Additional cultivars, selections, and seedlings were planted at Kearneysville, WV.

Eight triploid hop pollinators introduced - Corvallis, Oregon. A total of 8 triploid hop pollinators with medium early, medium, and late pollen shedding dates were released to commercial hop growers. These males have the potential of significantly increasing hop yields through physiological stimulation of increased cone size coupled with minimal production of unwanted seeds. The pollinators will be particularly useful to Washington hop growers for stimulating higher yields of Bullion and Brewer's Gold and to Oregon growers producing medium-late to late flowering hop cultivars with reduced seed content.



New hop selections being evaluated - Corvallis, Oregon. The high-alpha acid selections USDA 21193, 21194, and 21195 were planted in two small off-station tests in the Yakima Valley, WA, and in two small off-station tests in Oregon. Cone samples from the Washington and Oregon plots plus those from experimental plots near Corvallis confirmed the high-alpha acid potential of these three genotypes. USDA 21193 appears to have the greatest potential. This line is now being increased in preparation for large-scale commercial field trials in both States scheduled for 1980.

Imported hop varieties evaluated for U.S. production areas - Corvallis, Oregon. The Yugoslavian aroma cultivar Styrian was increased from soft-wood cuttings and about 8 acres were planted in 1979. The remainder of the 15-acre plot will be planted in 1980. Hersbrucker-G, a virus-free clone originally obtained from Germany, was increased in the greenhouse and about 4 acres were planted at a commercial Oregon location. One commercial Oregon plot of Tettnanger yielded about 1,200 lbs/acre in 1979 in its second mature year indicating that a premium price may be required for this cultivar to compete with Fuggle. Five-hill plots of ten clonal selections of Tettnanger were planted in a seedless test location in the spring of 1979.

Long-term storage of hop pollen appears feasible - Corvallis, Oregon. Freshly collected pollen of the four male genotypes 19036M, 19039M, 19172M, and 64103M was sent to Fort Collins, CO, in a thermos jar, packed in dry ice. A control sample was kept at Corvallis. After 3 days in liquid nitrogen, pollen was shipped back to Corvallis and used for pollinating receptive Cascade plants. Initial seed set data indicate that liquid nitrogen pollen storage is feasible, although seed set is reduced as compared to fresh pollen samples. Additional pollen samples are stored in liquid N at Fort Collins for pollination in 1980.

Non-suckering filbert rootstocks under test - Corvallis, Oregon. In research to develop non-suckering filbert rootstocks, open pollinated seed was harvested from 32 Corylus avellana-C. columna hybrids and resulted in over 1,000 seedlings. Over 771 seedlings from 7 crosses using C. avellana fusco-rubra as the male parent were established in the nursery for evaluation. About 50 percent of these seedlings are red leafed which indicates that they are true hybrids. Over 190 rootstock selections were top-worked to a commercial variety and were distributed to four cooperating growers.

New disease resistant germplasm identified for strawberries - Corvallis, Oregon. Following studies to identify clones for use as germplasm for resistance to the strawberry red stele fungus (Phytophthora fragariae), Olympus, OR-US 4457, and OR-US 4356 proved to have resistance. These will be used in the breeding program. Also classed as resistant and saved for future testing were 240 clones of the beach strawberry (Fragaria chiloensis) collected from the U.S. Pacific Coast. OR-US 4600 and OR-US 4612 show field tolerance to viruses and have been used in the breeding program.



Progress continues in pecan breeding - Brownwood, Texas. The testing of advanced pecan selections was continued by harvesting and evaluating 39 clones in a high density yield test, harvesting nut samples from 32 improved selections on their own rootstocks, and harvesting nut samples from over 100 young grafted selections. Nut samples from all tests were evaluated for quality, percent kernel, kernel color, and kernel configuration. Data on selections from 80 cooperative testing sites were obtained. This information will determine which selections are good enough for introduction as named varieties.

Scab resistance now a major objective of USDA pecan breeding program - Brownwood, Texas. Breeding for scab resistance is now a major objective of the USDA pecan breeding program. Seedlings were planted at Byron, GA, and subjected to natural disease infection. During the second year, 18 percent of 2,378 seedlings proved to have field resistance. These seedlings have been moved to Brownwood and will be evaluated for tree and nut characteristics.

Technological Objective 2: Develop new and improved cultural and management practices for fruits, nuts, and specialty crops that increase yield, minimize production losses, improve quality, and conserve use of natural resources.

NPS Contact: Howard J. Brooks

Research Locations:

Davis, California  
Indio, California  
Orlando, Florida  
Byron, Georgia  
Beltsville, Maryland  
Poplarville, Mississippi  
Stoneville, Mississippi  
Chatsworth, New Jersey  
Corvallis, Oregon  
Brownwood, Texas  
Weslaco, Texas  
Prosser, Washington  
Wenatchee, Washington  
Kearneysville, West Virginia

## Examples of Recent Progress:

### Virus-free grape varieties are widely distributed - Davis, California.

Indexing and thermotherapy was initiated, continued, or completed on grape materials received from grape breeding programs at Fresno and Davis as well as from Argentina, Australia, Bolivia, Chile, France, Germany, Hungary, Israel, Japan, Mexico, Spain, and South Africa. Barlinka from South Africa and Olmo 919 from the Davis breeding program, both of which were affected by heat-stable strains of leafroll and corky bark, were finally freed from disease by heating buds grafted on healthy rootstocks for 60 days at 38° C. Clean wood of standard grape disease indicators was furnished to indexing programs in Washington, British Columbia, and Mexico. Clean propagating materials of wine, table, and rootstock cultivars was furnished to farm advisors who will evaluate them for adaptability to western production areas.

### Immunity located for grape fanleaf virus - Davis, California.

An ELISA test was developed for grape fanleaf virus (GFV). With this test as well as with standard indexing tests, GFV could be recovered from the top portion of young plants of 14 grape cultivars that were directly inoculated by grafting fanleaf-infected buds near their base. The detection procedures, however, failed to recover the virus from 44 other germplasm lines that were similarly inoculated. The fanleaf immunity occurred in germplasm lines from Western Asia, the center of origin of Vitis vinifera. ELISA tests detected GFV in Brassica geniculata and Sonchus oleraceus, two weeds growing in a diseased vineyard.

### Three weeds and insect vector implicated in natural transmission of grape disease - Davis, California.

Toxin extracts from cultures of the Pierce's disease (PD) bacterium produced PD symptoms when vacuum infiltrated into grape cuttings. We prepared an antiserum to the PD bacterium with a titer of 4096. Using this antiserum, we developed a specific ELISA test for it in host plant tissues. Checking wild plants and weeds in the vicinity of PD-affected vineyards, we found three weed species with high concentration of PD bacteria in their tissues, Paspalum dilatatum, Conium maculatum, and Cyperus eragrostis. Where these weeds were not found the disease was absent from grapevines. Single vines of susceptible grape cultivars were occasionally found in areas with 100 percent PD incidence, but we have not yet established whether these are resistant types or disease escapes. Sharpshooter leafhoppers that were collected from a mountain meadow at an elevation of 7,200 feet in the Sierra Nevada at least 30 miles east of the nearest grape vineyard in Fresno County were infected with a high concentration of PD bacteria when they were checked by means of an ELISA test.

Phytophthora species shown to cause tree losses in almonds and cherries - Davis, California. Research has revealed for the first time that almond trees are subject to trunk canker caused by Phytophthora cactorum and P. cambivora. Previous to this work, the death of almond trees due to trunk canker in California's commercial orchards was attributed only to Ceratocystis fungus. To date, we have identified 11 different Phytophthora spp. that cause decline or death of almond trees in California. Also P. cactorum and P. cryptogea were isolated for that first time from dying cherry trees. Thus our research showed that at least 10 different Phytophthora spp. presently are implicated in root and crown rot of cherry trees in commercial orchards in California. Our research revealed that all of the Phytophthora spp. isolated from cherries are pathogenic to both presently used Mazzard and Mahaleb rootstock, but the relative resistance of these rootstocks was different to individual Phytophthora species.

Phytophthora species cause death of walnut trees in California - Davis, California. Phytophthora citricola and an unidentified Phytophthora species was isolated for the first time from walnuts in several orchards with high incidence of dead trees in northern San Joaquin Valley. In our pathogenicity tests, P. citricola was the most virulent among nine Phytophthora species isolated from walnuts thus far on Paradox, Juglans hindsii, and English walnut seedling walnut rootstocks. P. megasperma was the least virulent among Phytophthora species on the same 3 rootstocks. Contrary to previous assumption that Armillaria, wet feet, or sour sap are the major causes of root and crown rot of fruit and nut trees in California, our research showed that Phytophthora species are by far the most important pathogens implicated. These findings are essential for development of effective control measures for these extremely destructive and economically important diseases.

Cause of walnut tree losses now known - Davis, California. Contrary to the assumption in the literature that English walnut seedling rootstock is resistant and Paradox rootstock is susceptible to P. cactorum, the disease responsible for death of walnut trees in California's commercial orchards, our research showed that both English and Northern California black walnut seedlings are highly susceptible and Paradox rootstock is highly resistant to this pathogen. Four different selections of Paradox rootstock were significantly more resistant than English or black walnut rootstock to P. cactorum and P. megasperma while only one of the same Paradox selections was resistant to P. citricola and none was resistant to P. cinnamomi. Northern California black walnut is the most prevalent walnut rootstock and P. cactorum and P. megasperma are the most often associated with dead or dying walnut trees throughout California. This research strongly indicates that the use of resistant rootstock can minimize losses in walnut orchards.



Almond cultivars vary in susceptibility to leaf scorch disease - Davis, California. Our experiments confirmed field observations that almond cultivars differ in their susceptibility to almond leaf scorch (ALS). We have artificially inoculated 16 almond cultivars and we are studying the rate of ALS spread in the inoculated trees. This research showed that ALS spreads 5 to 10 times faster in Milo cultivar (450 cm) than in 10 other cultivars in which ALS spread ranged from 40 to 95 cm depending on the cultivar. The spread of ALS in the Peerless cultivar was 160 cm. No visible symptoms nor spread of ALS from the single infection sites was observed in Harvey, Ruby, Carmel, or Fritz cultivars within 2 years of observations. Thus more resistant cultivars should be planted in almond growing regions that have a history of ALS.

Nature of disease and cause of natural spread now known for walnut blackline - Davis, California. Walnut blackline is the most important factor limiting walnut production in some regions and has been a serious threat to the walnut industry in California since 1929. The disease has achieved a wide geographical distribution and epidemic status in several important walnut-producing areas because it has been previously considered to be a noninfectious disorder. Our research showed for the first time that walnut blackline is caused by a strain of cherry leafroll virus which can be spread and disseminated from infected to healthy trees or regions by propagation materials. Our research also demonstrated natural spread of blackline and strongly suggests that pollen is responsible for the spread of the disease from infected to healthy walnut trees within commercial orchards. This is the first experimental evidence on the etiology and epidemiology of blackline disease which shows that the use of healthy propagation material and removal of infected trees in orchards and nurseries as soon as they appear will be effective in controlling this economically important and destructive walnut disease.

Cause of prune brownline disease now known - Davis, California. Decline of the French and other prune cultivars, first observed in California in 1926, has been attributed by various workers to several different noninfectious causes. Our research showed for the first time that decline of prune trees is a much more serious problem of prune trees in California than it has been previously assumed and that it is a specific infectious disease caused by a strain of soilborne tomato ringspot virus. We also showed that the disease can be positively identified by the presence of a narrow strip of brown necrotic cambial tissue (brownline) at the graft union of the scion and rootstock of affected trees. The brownline disease spreads naturally from diseased to healthy trees in commercial orchards and it can be disseminated from infested to healthy growing areas by propagation material. This is the first time to show that prune decline associated with brownline at the union is an infectious disease. The assumption in the past 50 years that this type of decline of prune trees is an uninfected disorder has been the major factor for uncontrolled spread and a wide geographical status of this devastating prune disease.

Isozyme techniques show promise as means to identify unknown date varieties - Indio, California. A quality control system to determine the clonal nature of date plantlets is being investigated. Histological evidence indicates that asexual and zygotic embryos develop through similar ontogenic sequences. Genetic stability of tissue cultured plantlets, as measured by isozymes of several gene enzyme systems, has been tested using starch gel electrophoresis. A catalog of 7 gene enzyme systems has been compiled for 45 female and 20 male date palms. Analyses of isozymes could be used in identification of unknown varieties, determining genetic resemblance of backcrossed male palms to females, and assessing the genetic stability of tissue cultured plantlets.

Differences in blight susceptibility found in varietal strains of citrus - Orlando, Florida. Differences in blight susceptibility were found among 8 strains of Hamlin propagated on rough lemon rootstocks. These differences ranged from 7 percent blight in selection H61-3-17-X to 27 percent in H8-1-4-XE. Exocortis-carrying selections were less blight susceptible than exocortis-free selections.

Endomycorrhizal fungi found in roots of citrus trees - Orlando, Florida. Endomycorrhizal fungus development was evaluated in fibrous roots of tree in 8 citrus groves affected with blight. Percent of fibrous root infection was similar between blighted and nonblighted trees on various soil types, under nitrate and an equal mixture of nitrate and ammonium nitrogen fertilization, and regardless of the hydraulic conductivity of the parent pioneer roots. Overall, blight trees had a mean of 83.7 percent endomycorrhizal fungus infection and healthy trees had a mean of 90.4 percent infection. These data suggest that endomycorrhizal fungi are effective symbionts in both blighted and healthy trees.

Fusarium toxins from citrus roots have been purified and identified - Orlando, Florida. Single-spore isolates of Fusarium solani obtained from fibrous roots of citrus trees exhibiting blight symptoms and from a diseased greenhouse-grown tree were evaluated for toxin production. Several isolates from roots of blight-disease trees yielded culture extracts which severely inhibited root growth of radish seedlings. Inhibitory effect of extracts was due primarily to their content of naphthoquinone derivatives. Toxins purified and identified from culture extracts included fusarubin, javanicin, and anhydrofusarubin.

Water movement found to be restricted in blight infected trees - Orlando, Florida. Research was conducted to evaluate the water potential of different aged xylem tissues in healthy and blight affected trees. Measurement techniques used were water uptake by gravity infusion, dye distribution following gravity infusion, and waterflow by vacuum. Limbs and roots, 2 to 5 cm in diameter, of healthy and blight affected trees had similar water movement characteristics. However, water movement of blight affected trees was greatly reduced in 10 to 15 cm scaffold limbs, trunks, and in roots of less than 2 cm. Older xylem vessels in trunks and large limbs were more subject to blight induced

restricted water movement and dye patterns suggested that lateral water movement was restricted in blighted trees.

Citrus blight apparently unrelated to source of nitrogen - Orlando, Florida.

A long-term monitoring experiment of  $\text{NH}_4$ ,  $\text{NO}_2$ , and  $\text{NO}_3$ , treatments under blight and healthy trees was concluded. Nitrate levels were slightly higher under healthy trees than under blight trees in late fall; there were no differences in  $\text{NH}_4$ . This indicates that source of nitrogen is apparently unrelated to incidence of citrus blight.

Cold hardiness of citrus related to photosynthesis and carbohydrate-water relationships - Orlando, Florida. Research was initiated to determine proline accumulation during cold hardening in order to complete the triad of sugars-water-proline in citrus cold hardiness. Proline accumulation, implicated in citrus freeze survival, was completed in a series of studies under controlled temperature regimes. Accumulation of free proline in citrus leaves is a characteristic feature of citrus cold hardening and seemingly is influenced by rootstock. Increases in proline are accompanied by increases in sugars and changes in tissue water balance. Neither proline nor sugars increased in dark treatments which also decreased cold hardening. Data implicate photosynthesis and a sugar-water-proline triad relationship in the cold hardening process.

Tree wraps being studied to protect citrus trees from freeze damage - Orlando, Florida. In a cooperative study with industry research personnel, protective wraps were evaluated for protecting citrus tree trunks during freeze conditions. Fiberglass wraps were found effective during moderate freezes ( $23^\circ\text{F}$  for 3 hours) but wraps did not compare favorably with protection provided by soil banks. Wet wraps provided  $1^\circ$  to  $2^\circ$  additional protection in contrast to dry wraps during the initial stages of a freeze. This protection is of limited value during severe freezes. Research was started on a new type of citrus insulator utilizing both the temperature moderating effect of water and the resultant latent heat of fusion during freezing.

Mycorrhizal fungi in citrus roots increase leaf carbohydrates - Orlando, Florida. Soluble carbohydrates and sucrose were found to be significantly higher in leaves of mycorrhizal citrus rootstocks than in nonmycorrhizal plants. No differences were apparent in the roots of these plants. Reducing sugars and starch were higher in leaves of infected plants but only reducing sugars were higher in roots of the infected plants. There was little difference in total and reducing sugars in leaves of mycorrhizal inoculated citrus and nonmycorrhizal citrus grown in phosphorus-amended soil to achieve growth equivalent to the mycorrhizal plants.



Citrus trees infected with citrus blight have reduced energy levels - Orlando, Florida. The level of adenine triphosphate activity (a measure of energy) found in blighted trees was lower than that of nonblight leaf tissue by at least 50 percent. This lowering of activity was found to occur in all ages of tissue and indications are that diagnosis of early blight can be accomplished by using a refinement of this technique. Work is in progress to improve sensitivity.

Stomatal function and tissue water relations apparently not associated with citrus blight - Orlando, Florida. In a study to determine if diurnal water relations differ between blighted and nonblighted citrus trees, the diurnal water relations of citrus affected by blight were found to have similar water relations to nonblighted trees. Blight affected trees experienced more water stress due to the presence of fewer, small leaves, less leaf area per tree, lower stomatal conductances, and lower transpiration rates. These differences do not result in any apparent changes in specific leaf weight, leaf osmotic potentials, or in the critical leaf water deficits at which leaf turgor is lost. It is concluded that the symptoms associated with blight are not a result of lost stomatal functions or changes in other characteristics of tissue water relations.

Suitable abscission chemicals still unavailable for mechanical harvesting of Valencia orange trees - Orlando, Florida. Research continues on development of a combination of abscission chemicals more efficient than those now available for use during the nonresponsive period of Valencia oranges. The most efficient of all combinations without young fruit injury was 5 ppm Acti-Aid plus 125 ppm Release with 0.1 percent Triton X-100. The fruit removal force (FRF) was lowered from 10.5 kg to 5 kg; however, for good mechanical harvest the FRF should be lowered to about 2.5 kg. To lower the FRF to that level requires chemical above recommended rates which result in young fruit injury. Additives, such as urea, ethephon, CGA 15281, and calcium did not increase effectiveness of the abscission chemicals.

Johnson grass implicated as natural reservoir of phony disease of peach - Byron, Georgia. Rickettsia-like bacteria (RLB) were consistently observed in KOH extracts of Johnson grass stems collected in peach orchards infected with phony disease. Electron microscopic examination of xylem in leaves of Johnson grass revealed the presence of RLB morphologically similar to those causing phony peach and other xylem-limited, leafhopper-borne diseases. Johnson grass RLB were antigenically related to RLB causing phony peach and Pierce's disease of grapes and thus are regarded to be closely related to the phony disease organism. The evidence suggests a possible role of Johnson grass as a natural reservoir of phony peach disease.

Prunus necrotic ring spot virus found to be high in Georgia peach orchard - Byron, Georgia. Positive hypersensitive responses on Shirofugen limbs to Prunus necrotic ring spot virus (PNRV) were obtained throughout the growing season contradicting reports that under conditions of high ambient temperatures in the late summer this bioassay method cannot be used. In a preliminary survey of peach trees in an orchard in decline, 51 percent of 43 trees sampled were positive for PNRV. These results were confirmed with an ELISA test performed on duplicate samples by a collaborator at the Tree Fruit Research Center, Wenatchee, WA. Fourteen percent of the positives were trees with no evident sign of decline.

Peach production increased by the use of drip irrigation - Byron, Georgia. Drip irrigation increased grower returns from peaches during the drought years of 1977 and 1978. 1979 was considered a year with ample moisture but preharvest irrigation of 300 to 600 gallons/tree increased marketable yields by about 80 bu/acre over the non-irrigated yield of 310 bu/acre. At the prevailing price of peaches, this was an increase in gross return of about \$600/acre.

Pecan trees are slow to accumulate zinc from soil applications of zinc sulfate - Byron, Georgia. Data are now available from a 5-year study to determine the effect of method and rate of zinc application on zinc concentration of pecan leaves. Zinc sulfate was applied in 1975 to mature trees at rates of 0, 50, 100, 200, and 400 lbs/acre in either a band (3-6 inches) around the tree or broadcast. Beginning in 1975 and continuing through 1979, the 400/lb broadcast rate has been the best rate and until 1979 was the only rate to raise the zinc concentration in the leaf above the critical concentration of 50 ppm. In 1979, the 100 and 200 broadcast rates increased the leaf concentration of zinc above 50 ppm. Also in 1979 the equivalent rate of 400/lbs in the band increased the zinc concentration in the leaf above 50 ppm.

Oil content of pecan kernels decreases with yield - Byron, Georgia. Yield of Moneymaker pecan trees was positively correlated with refractive index of oil in meats and negatively correlated with percent oil. Phenolic content of meats was not correlated with yield. Increase in aflatoxin accumulation in meal from high yielding trees was not related to phenolics.

Apomictic seedlings of Malus hupehensis found useful for study of physiology of flowering - Beltsville, Maryland. The usefulness of the apomictic crab-apple, Malus hupehensis, for tree physiology studies has been established. Seedlings of this species grow rapidly in the greenhouse under long days reaching a height of 2 m in 6 months or less. Flower bud initiation occurred in the greenhouse and open flowers were obtained in as little as 10 months from seed germination. The proximal flower bud usually occurred about 2 m above the cotyledon, approximately the 75th node. More rapid seedling growth could be obtained by starting the seedlings in a growth chamber with increased levels of CO<sub>2</sub>, nutrients, and light. A spray

application of cytokinin was developed to break bud dormancy on M. hupehensis permitting easier evaluation of flowering. The inhibitor of ethylene biosynthesis, rhizobitoxine, was shown to inhibit bud growth in M. hupehensis but no direct role for ethylene in breaking could be established.

Fluidized bed material useful to improve orchard soils - Beltsville, Maryland. Fluidized bed material, a by-product of coal burning, has been found a useful treatment to improve orchard soils. It can increase the pH of the soil and twice the amount of limestone on a weight basis is needed to induce the same pH change. In greenhouse and field studies, it was obvious that fluidized bed material does not present any problems in any of the aspects of the fruit production. It also can serve as an effective calcium source for the trees.

Magnesium content in plum leaves found to be poorly correlated with soil content - Beltsville, Maryland. Diagnostic techniques to identify magnesium deficiency in a wide variety of plums have been developed. Leaf age and time of sampling for best determination of the magnesium status of the tree was determined. Generally there was a poor correlation between magnesium content and leaf magnesium concentration but correlation was high between woil and leaf potassium.

Abnormal cell division found in apples affected with cork spot - Beltsville, Maryland. Abnormal division of nucleus occurs in fully developed cells of apples affected by the cork spot disorder. The division produces daughter cells within the original cell and can be classified as within-the-cell cell division. The division occurs several times, always resulting in smaller and smaller cell compartments as the new cell walls divide the space. This phenomenon was observed for the first time in plants and it causes a hard lump-like tissue. The biochemical aspects of cork spot have been studied before but now it is clear that cork spot starts as an abnormal cell division.

New tree training system may encourage nectarine production in the East - Beltsville, Maryland. In a study to help small acreage farmers, nectarine trees were trained to a wire trellis and pruned to a palmette system. The yield, size of fruit, and the freeness from brown rot on the Beltsville palmette was outstanding. If the resistance to brown rot disease can be repeated, which at this time appears to be likely, small farmers may have a very good money-producing crop to add to the variety of fruits they now grow. Nectarines are presently produced only in California where the dry climate permits growing fruit free of brown rot. The Beltsville palmette tree training allows the penetration of sunshine and pesticides into the tree much better than the conventional tree which may improve the control of brown rot.



Tolerance to Xanthomonas fragariae disease found in strawberries - Beltsville, Maryland. Studies have been conducted to identify strawberry varieties that are resistant to Xanthomonas fragariae. After testing 13 strawberry varieties, 3 groups are tentatively established: Earliglow, Guardian, Sparkle, and Stelemaster are susceptible; Raritan, Midland, Fletcher, Surecrop, Blakemore, and Suwannee are of intermediate susceptibility; and Badgerbelle and Atlas are tolerant.

Source of nitrogen important for production of rabbiteye blueberries - Poplarville, Mississippi. A 2-year sand culture study showed  $(\text{NH}_4)_2\text{SO}_4$  superior to  $\text{NaNO}_3$  as a nitrogen source for rabbiteye blueberries. Plants fertilized with  $(\text{NH}_4)_2\text{SO}_4$  had higher fruit yield, plant vigor, and mineral uptake. Calcium fertilization resulted in leaf calcium concentrations in Tifblue blueberries equivalent to those reported for lowbush and highbush blueberries but increase in calcium did not affect plant yield or vigor.

Strawberries and blackberries show promise for pick-your-own operations in the Gulf States - Poplarville, Mississippi. Yield data from the 1979 strawberry variety test show that Florida 90, Apollo, and Darrow were significantly higher in yield than the other 11 varieties tested. Darrow and Apollo varieties had the largest fruit size. Additional variety tests were started in the fall of 1979 at 2 different locations having different soil types. Second year yield data from the erect blackberry variety studies indicate that Brazos, Cheyenne, and Comanche were the highest producers. The same three varieties also had the largest fruit. Cherokee had the highest percent of sugar of all varieties tested. Thus, both strawberries and blackberries show promise for pick-your-own operations in the Gulf States.

Less physiological breakdown found in cranberries harvested by mechanical means. - Chatsworth, New Jersey. Studies on the fresh market shelf-life of water harvested cranberries were continued. Hand picked and water reel picked cranberries were divided into 4 color categories, held in the bog water for intervals up to 24 hours, removed, cleaned, dried, and stored up to 12 weeks at  $3.5^\circ\text{C}$ . More fungal decay was found in water reel harvested fruit than in hand picked fruit. More physiological breakdown of the fruit occurred in hand picked berries and, contrary to previous assumptions, the lighter colored fruit developed more physiological breakdown than did the darker fruit.

Stem canker disease of blueberry now prevalent in New Jersey plantings - Chatsworth, New Jersey. In research to determine the incidence of stem canker disease in New Jersey blueberry plantings, a 20-field survey for stem canker disease in the Hammonton, NJ, growing area was conducted with the cooperation of New Jersey State plant nursery inspectors. Stem canker, a serious fungus disease in North Carolina, was found in 50 percent of the 2,000 plants inspected. The disease is widespread in the Hammonton area and it appears that the fungus is adapting to New Jersey growing conditions.

Virus-free blueberry planting established in New Jersey - Chatsworth, New Jersey. Establishment of a virus/mycoplasma free source of blueberry cultivars was initiated at Chatsworth with a collection of 32 cultivars. A total of 49 stunt infected plants were removed (two inspections) from a collection of 26 cultivars at Rutgers University, New Brunswick. This collection will serve as a source of virus/mycoplasma free cutting wood once it is judged to be free of disease.

New technique developed for filbert propagation - Corvallis, Oregon. In a research program to develop improved filbert propagation procedures, standard T-budding was compared to a new technique called greenleaf chip budding. One month after July, August, or September placement, T-buds recorded 13 percent success while greenleaf chip budding was 91 percent. Since bud survival has been a problem, all buds were checked again in December when 31 percent of the buds placed by the greenleaf chip budding technique survived compared to 1 percent survival for standard budding.

Rubus viruses detected for the first time with the new ELISA technique - Corvallis, Oregon. Progress is being made on small fruit virus purification, antiserum preparation, and utilization. Raspberry bushy dwarf virus (RBDV), a black raspberry strain, was purified from Chenopodium quinoa and was used to prepare antiserum in rabbits. This RBDV antiserum was successfully used for the first time to develop a rapid virus detection procedure using enzyme-linked immunosorbent assay (ELISA) in Rubus cultivars. Additional ELISA procedures were developed to detect two viruses (tobacco streak and tomato ringspot) in Rubus and strawberry.

Blackberry diseases are found to be graft transmissible - Corvallis, Oregon. In a project to establish graft-transmissibility of some leaf-patterning disorders of Rubus in the Pacific Northwest, greenhouse tests revealed that Loganberry calico, Marion calico, and Chehalem calico diseases of blackberry are graft-transmissible (first report). Each can be distinguished from the others by graft analysis on several blackberry cultivars. Marion blackberry is suitable as a detection indicator for these disorders. A similar calico pattern was found in Olallie blackberry in California.

Hop aroma found to be associated with specific chemicals in the hop cone - Corvallis, Oregon. Eleven commercial hop genotypes were ranked from 1 to 10 for their aroma values as recognized by the trade. Aroma scores improved with decreasing cohumulone values and with increasing values of the ratio of humulene to caryophyllene, C/H (sesquiterpene constituents of the essential oils). High correlations between cohumulone and C/H were found for both female and male samples . . . -0.90 and -0.87 respectively. It appears that the new value C/H may be useful in identifying aroma types either for advancement or for breeding.

Potential parents identified for increasing production of lavendaceous odored mint oils - Corvallis, Oregon. Mentha citrata, M. aquatica, and



hybrids from these and other mint species were identified as potential parents to breed for lavendaceous odored mints. Oils were collected from individual plants by steam distillation and analyzed for chemical composition. Oil yield in this group of mints ranged from 0.5 to 3.5 percent of plant material on a dry weight basis. Commercial mints yield about 1.5 percent on a dry weight basis.

Mint species and genotypes prove to be extremely variable for desirable characteristics - Corvallis, Oregon. Mint oils from 480 different genotypes were collected by steam distillation. Ninety percent of the oils differed in chemical composition and/or concentration. This observation was true even within the same specie. Some oils were complex, having over 60 chemical components while others were composed of 1 or 2 major compounds. Over 600 individual mint genotypes growing in field plots were evaluated for resistance to the mint rust disease. Ideal conditions for this work existed in 1978 and 1979 where the pathogen was present in epidemic proportions. Many of the ultra-susceptible plants were completely defoliated by the pathogen. Some plants exhibited a high level of resistance but 103 of the entires were immune to mint rust.

Commercial interests propagate new USDA virus-free hop material - Corvallis, Oregon. A commercial nursery agreed to increase hop planting stock of virus-free Fullion and Brewer's Gold for Oregon hop growers on a contract-free basis. Starter material was provided by the USDA hop research project free of charge. By mid-summer 1979 over 50,000 potted plants of each cultivar were ready for distribution to interested growers. Due to limitations of manpower and greenhouse space, a project of this magnitude could not have been successful without the cooperation of a commercial interest. This phase of work in the future will be continued by commercial propagators.

New systemic fungicide controls downy mildew disease of hops - Corvallis, Oregon. Five test plots in different commercial hop yards in the Willamette Valley, OR, were treated with Ridomil, a systemic fungicide. A total of 2,029 hills were treated either as a soil drench in early April or as a foliar spray later in the season. Hops were harvested from two of the five plots and compared to an equal number of control plots. A single application of Ridomil as a soil drench in early spring effectively controlled hop downy mildew. However, some phytotoxicity was noted on young shoots which was probably due to the carrier compound in the formulation.

Hours of leaf wetness useful in timing fungicide sprays on pecans - Brownwood, Texas. Fungicide spray schedules for pecan trees usually require a minimum number of applications with additional sprays called for in seasons of high rainfall or humidity. The difficulty encountered by growers is to determine how much wet weather warrants additional sprays. Accumulated hours of leaf-wetness was found to be a reliable index to determine when extra sprays were needed. Up to three spray applications were saved in dry years. With optimal disease control and additional



sprays applied after each 125 hours of leaf wetness in a wet year, disease control was increased over that obtained with a minimum spray schedule. The leaf-wetness method of determining the need for additional sprays is being used by pest management programs in Alabama and Texas. When fully implemented, modifying spray schedules with leaf-wetness hours could save growers up to 3 to 6 million dollars a year.

Differences in freeze damage found in citrus rootstocks - Weslaco, Texas. Young Nucellar Redblush grapefruit trees in salt tolerance tests using trickle and flood irrigation were exposed to a natural freeze of  $-5.6^{\circ}\text{C}$  for 3.5 hours. Highly significant rootstock differences showed that Cleopatra mandarin, Rangpur lime, Citrumelo W-2, and Rusk citrange rootstock selections had good cold tolerance. Trees with Troyer and Carrizo citrange, and Alemow, Ponderosa, Iran, and Golden de Georgio lemon rootstock selections had poor cold tolerance. Trickle and flood irrigation did not induce differences in cold hardiness with this group of rootstocks which showed a wide range of Cl and B uptake.

Short trellis system being tried experimentally with hop production - Prosser, Washington. Cascade, Rivard, Galena, and experimental hop selection 47-17 produced the same on both the 2.15 meter short trellis and the conventional 5.54 meter high trellis. Alpha-acid content was increased 10 to 50 percent in five hop varieties grown on the low trellis. The low trellis system also included trickle irrigation, fertigation, systemic pesticides, and no cultivation. A commercial experimental hop harvester was successful in picking the hops from the short trellis.

Solar energy used to dry hops - Prosser, WA. A 1,200 foot solar collector reduced oil consumption of hop drying operations by 7 percent. An additional 8 percent saving was accomplished by recirculating the warm air after it passed through the bed of hops. The solar and recirculating system did not affect hop quality. Loose and baled hops with 18 percent moisture were further dried to 8 percent moisture in a vacuum microwave system without changing quality. Fresh hops containing 78 percent moisture were baled and dried in the vacuum microwave with minimal discoloration and quality similar to the control. Microwave drying did not affect either the oxidation rate or storageability of baled hops.

Virus isolates from eastern and western grown trees appear to be serologically different - Wenatchee, WA. Union necrosis and decline is becoming a serious problem with apple trees grown on MM 106 rootstock in the East. The causal agent of the disease is tomato ringspot virus and was detected in a shipment of rootstocks from Oregon. In tests at Wenatchee it was determined that the eastern and western isolates of tomato ringspot virus are not serologically identical. Antiserum to the eastern strain and the peach stem pitting isolate of tomato ringspot virus (also a problem in the East) than with the western isolate. This indicates that much of the union necrosis and decline problem in the East could be attributed to sources other than contaminated nursery stock from the Pacific Northwest.

Stemless sweet cherries may become a reality - Wenatchee, Washington. Field testing of ethylene generating chemicals for inducing abscission of sweet cherries has been completed. Results indicate technique is feasible. Final adoption of practice will depend on further testing to determine fruit quality at the market and consumer acceptance.

Cold hardiness of apple trees affected by fall weather and mid-winter warm spells - Wenatchee, Washington. Cold hardiness tests of Delicious and Golden Delicious apple trees that were monitored at bi-weekly intervals during the dormant season (1978-79) indicated approximately 6°C greater hardiness than in previous years tested. This may be attributed to below normal temperatures during the fall and early winter. Percent dry matter and sorbitol in the sap of 2-year wood was correlated with temperature. An artificial "warming test" in January indicated that cold hardiness of apple wood may be reduced by 4°C or more. Over-tree misting of Delicious apple trees in September and October induced early cold hardiness by approximately 6°C. Various foliar sprays of nitrogen, calcium, and zinc applied in mid-October did not enhance winter hardiness. Rootstock studies during 1978-79 revealed that Antonovka was the most hardy.

New growth regulator reduces fruit drop and promotes branching of apple trees - Wenatchee, Washington. An endogenous ethylene inhibitor Aminoethoxyvinylglycine (AVG) applied to Delicious and Golden Delicious apple trees either in the fall or spring reduced the amount of fruit drop and increased the number of bud breaks and total vegetative growth. The most vegetative growth response occurred the season after the fall application. The most reduction in fruit abscission (June drop) was obtained from the spring application. AVG increases branching on seedlings and nursery trees without reducing growth. Promalin also increases growth and branching of nursery stock. All other feathering and pinching agents reduce terminal growth before branching occurs.

Soil nutrition found related to apple and pear fruit quality - Wenatchee, Washington. Golden Delicious trees receiving one-half standard rate of  $\text{NH}_4\text{NO}_3$  fertilizer plus a late spring foliar urea spray, three  $\text{CaCl}_2$  sprays, and simazine weed control sprays produced more consistent yields of extra fancy fruit from 1974 to 1979 than other treatments. Alfalfa greening of Anjou pears appears to be related in part to excesses of nitrogen fertilization and irrigation, heavy pruning, and rootstocks. High levels of nitrogen and low levels of calcium occur in affected fruit. In many cases, sprays of  $\text{CaCl}_2$  reduced the incidence of alfalfa greening and corkspot of Anjou but some spray injury occurred on the leaves and surface of the fruit.

## P U B L I C A T I O N S

### Davis, California

Mircetich, S.M. 1979. Blackline research: 50-year-old disorder found to be spreading. Diamond/Sunsweet News 1: 8, 9-25.

Mircetich, S.M., R. R. Sanborn, D. E. Ramos, J. A. Lauritis, G. A. DeZoeten, J. Refsguard, and J. W. Hoy. 1980. Recent research advances in elucidation of etiology and epidemiology of walnut blackline disease. p. 21-22. In Proceedings of the XII Annual UC Walnut Research Conference, Chico, CA. January 29-30, 1980.

Mircetich, S. M. 1980. Blackline of walnut caused by graft transmissible virus that spreads from diseased to healthy trees by pollen. Diamond/Sunsweet News 2:4, 21-22.

Mircetich, S.M. and J. W. Hoy. 1980. Brownline - a newly recognized disease of prune trees caused by tomato ringspot virus. Diamond/Sunsweet News 2: 5, 22.

Goheen, A. C. 1979. Development of grape production in Bolivia. Working Paper No. 006/79, Consortium for International Development, LaPaz, Bolivia, 15 pp.

Kahn, R. P., H. E. Waterworth, A. C. Gillaspie, Jr., J. A. Foster, A. C. Goheen, R. L. Monroe, W. L. Povich, R. G. Mock, C. F. Luhn, E. C. Calavan, and C. N. Roistacher. 1979. Detection of viruses or viruslike agents in vegetatively propagated plant importations under quarantine in the United States, 1968-1978. Plant Dis. Rept. 63: 775-779.

Goheen, A.C., B. C. Raju, S. K. Lowe, and G. Nyland. 1979. Pierce's disease of grapevines in Central America. Plant Dis. Rept. 63: 788-792.

### Fresno, California

Ramming, D. 1978. Stone fruit and grape production. In California Rare Fruit Growers Yearbook. Edited by J. M. Riley and P. H. Thompson. pp. 74-77.

### Indio, California

Tisserat, B. 1979. Propagation of date palm (Phoenix dactylifera L.) in vitro. J. Exp. Bot. 30: 1275-1283.

Tisserat, B. 1979. Tissue culture of the date palm. J. Hered. 70: 221-222.



Tisserat, B., G. Foster, and D. DeMason. 1979. Plantlet production in vitro from Phoenix dactylifera L. Date Growers' Inst. Rep. 54: 19-23.

Tisserat, B., and A. M. Torres. 1979. Isozymes as genetic indicators in date palms. Date Growers' Inst. Rep. 54: 24-29.

Carpenter, J. B. 1979. Breeding date palms in California. Date Growers' Inst. Rep. 54: 13-16.

Carpenter, J. B. 1979. The national date palm germplasm repository. Date Growers' Inst. Rep. 54: 29-32.

#### Orlando, Florida

Albrigo, L. G., and R. H. Young. 1979. Citrus tree decline complex and diagnostic identification of blight. Proc. Fla. State Hort. Soc. 92: 61-63.

Bar-Joseph, M., J. M. Sacks, and S. M. Garnsey. 1978. Detection and estimation of citrus tristeza virus infection rates based on ELISA assays of packinghouse fruit samples. Phytoparasitica 6: 145-149.

Bar-Joseph, M., S. M. Garnsey, D. Gonsalves, M. Moscovitz, D. E. Purcifull, M. F. Clark, and G. Loebenstein. 1979. The use of enzyme-linked immunosorbent assay for detection of citrus tristeza virus. Phytopathology 69: 190-194.

Bar-Joseph, M., S. M. Garnsey, and D. Gonsalves. 1979. The closteroviruses: A distinct group of elongated plant viruses. Adv. Virus Res. 25: 93-168.

Garnsey, S. M., and R. G. Christie. 1979. Citrus tristeza virus indexing by light microscopic observation of viral inclusions. Phytopathology 69: 1028.

Hearn, C. J. 1979. Sunburst citrus hybrid. Hort-Science 14(6): 761-762.

Hearn, C. J. 1979. Performance of Sunburst, a new citrus hybrid. Proc. Fla. State Hort. Soc. 92: 1-3.

Nemec, S., and M. Patterson. 1979. Comparative growth of mycorrhizal and nonmycorrhizal citrus in the field in Florida. Citrus Industry 60: 31-40.

O'Bannon, J. H. and S. Nemec. 1979. The response of Citrus limon seedlings to a symbiont, Glomus etunicatus, and a pathogen, Radopholus similis. J. Nematol. 11: 270-275.

Timmer, L. W., S. M. Garnsey, G. R. Grimm, N. E. ElGholl and C. L. Schoulties. 1979. Wilt and dieback of Mexican lime caused by Fusarium oxysporum. Amer. Phytopath. Soc. 69: 730-734.

Timmer, L. W. and S. M. Garnsey. 1979. Variation in the distribution of citrus ringspot and psorosis viruses within citrus hosts. Phytopathology 69: 200-203.

Weiser, C. J., H. A. Quamme, E. L. Preobstin, M. J. Burke, and G. Yelenosky. 1979. Plant freezing injury and resistance. In Modification of the aerial environment of plants. Section II Plant-stress-environment relationship. Amer. Soc. Agr. Eng. Monograph pp. 55-84.

Wutscher, H. K., and C. Hardesty. 1979. Concentrations of 14 elements in tissues of blight-affected and healthy Valencia orange trees. J. Amer. Soc. Hort. Sci. 104: 9-11.

Wutscher, H. K. 1979. Citrus in Argentina, Uruguay, and Brazil. Citrograph 64(11): 279-281.

Wutscher, H. K., and C. A. Hardesty. 1979. Ammonium nitrite, and nitrate nitrogen levels in the soil under blight-affected and healthy citrus trees. Commun. in Soil Science and Plant Analysis 10(12): 1495-1503.

Wutscher, H. K. 1979. Minor element use in citrus. Citrus & Veg. Mag. 43(4): 15, 49-52.

Wutscher, H. K., and C. Hardesty. 1979. Zinc and phenolics in the wood and incidence of citrus blight in a grove containing eight selections of Hamlin orange. Proc. Fla. State Hort. Soc. 92: 70-72.

Yelenosky, G. 1978. The effect of withholding water on cold hardiness of Valencia orange and Star Ruby grapefruit trees in controlled freezes. Proc. Fla. State Hort. Soc. 91: 18-20.

Yelenosky, G. 1979. Water-stress-induced cold hardening of young citrus trees. J. Amer. Soc. Hort. Sci. 104: 270-273.

Yelenosky, G. 1979. Accumulation of free proline in citrus leaves during cold hardening of young trees in controlled temperature regimes. Plant Physiol. 64: 425-427.

Yelenosky, G. 1979. Sensitivity of budded young orange trees and grapefruit seedlings to ancymidol (EL-531) in soil mix. J. Amer. Soc. Hort. Sci. 14 (5): 600-602.

Yelenosky, G. 1979. Self-heating tree wraps in freeze protection. Proc. Fla. State Hort. Soc. 92: 25-27.

Yelenosky, G. 1979. Bark-splitting from freezy injury of young citrus trees on different rootstocks. Proc. Fla. State Hort. Soc. 92: 28-31.

Young, R. 1979. Water movement in limbs, trunks, and roots of healthy and blight-affected Valencia orange trees. Proc. Fla. State Hort. Soc. 92: 64-67.

Young, R. H., and S. M. Garnsey. 1979. A hypothesis to explain the tree age factor in the ontogeny of citrus blight. HortScience 14(3):460.

Young, R. H., S. M. Garnsey, and G. Horanic. 1979. A device for infusing liquids into the outer xylem vessels of citrus trees. Plant Dis. Reprtr. 63: 712-715.

Nemec, S., and J. H. O'Bannon. 1979. Response of Citrus aurantium to Glomus etunicatus and G. mosseae after soil tretatment with selected fumigants. Plant and Soil 53: 351-359.

Rose, A. J., and G. Yelenosky. 1978. Citrus trunk wrap evaluation. Proc. Fla. State Hort. Soc. 91: 14-18.

Rasmussen, G. K. 1979. Results of 5 years continued use of abscission-inducing chemicals on Hamlin oranges. Proc. Fla. State Hort. Soc. 92: 51-53.

#### Beltsville, Maryland

Keil, H. L. and E. L. Civerolo. 1979. Effects of trunk injection of oxytetracycline on bacterial spot disease in peach trees. Plant Dis. Reprtr. 63: 1-5.

Faust, M. 1979. Evolution of fruit nutrition during the 20th century. HortScience 14: 321-359.

Korcak, R. F., Gouin, F. R. and Fanning, D. S. 1979. Metal content of plants and soils in a tree nursery treated with composted sludge. J. Environ. Qual. 8(1): 63-68.

Korcak, R. F. 1979. Fluidized bed material as a calcium source for apples. HortScience 14(2): 163-164.

Miller, R. H. 1977. Fruit, germination, and developmental morphology of Salacca edulis palm seedling. Phytomorphology 27(3): 282-296.

Maas, J. L., F. G. Pollack, and F. A. Uecker. 1979. Morphology and development of Pilidiella quercicola. Mycologia. 72: 92-102.

Brown, J. C. and A. D. Draper. 1980. Differential response of blueberry (Vaccinium) progenies to pH and subsequent use of Iron. J. Amer. Soc. Hort. Sci. 105: 20-24.



Draper, A. D. 1979. Highbush blueberry cultivars. Fruit Var. J. 33(2): 48-50.

Galletta, G. J. 1979. Strawberry cultivars for Eastern and Midwestern North America. Fruit Varieties J. 33(2): 39-43.

Galletta, G. J. 1979. II Miglioramento Genetico Della Fragola Negli Stati Unite Negli Ultime 10 Anni: Obiettivi e Risultati (Strawberry breeding in the United States in the last 10 years: progress and objectives). Societa Oritcola Italiana Incontro Nazionale Sulla Fragola Ferrara 1979: 103-117.

McGrew, J. R. 1978. Grapes are versatile fruits and have market potential. USDA YB Agr. 180-187.

McGrew, J. R. 1979. Downy mildew. Eastern Grape Grower. Oct. 1979:56-57.

Ballinger, W. E., G. J. Galletta, and E. P. Maness. Anthocyanins of fruits of Vaccinium, subgenera Cyanococcus and Polycodium. J. Amer. Soc. Hort. Sci. 104(4): 554-557.

Neunzig, H. H. and G. J. Galletta. 1977. Abundance of the blueberry bud mite (Acarina:Eriophyidae) on various species of blueberry. J. Georgia Entomol. Soc. 12(2): 182-184.

#### Poplarville, Mississippi

Spiers, J. M. Growing the rabbiteye blueberry. 1978. Deep East Texas Fruit Conf. pp. 25-28.

Spiers, J. M. Effect of pH level and nitrogen source on elemental leaf content of Tifblue rabbiteye blueberry. J. Amer. Soc. Hort. Sci. 103(6) 705-708. 1978.

Spiers, J. M. Blueberry variety studies in South Mississippi. Ms. Agr. and For. Expt. Station Research Report, Vol. 4, No. 10, 3 pp. 1979.

#### Chatsworth, New Jersey

Eck, Paul and A. W. Stretch. 1979. Cutting wood production from highbush blueberry mother block plants as affected by nitrogen nutrition and fungicide treatment. HortScience 14(5): 599-600.

#### Wooster, Ohio

Blake, R. C. and T. van der Zwet. 1979. The USDA pear breeding program. III Fruit evaluation. Fruit Var. J. 33:4.

Corvallis, Oregon

- Converse, R. H. 1979. Recommended virus indexing procedures for new USDA small fruit and grape cultivars. Plant Dis. Reptr. 63: 848-851.
- Converse, R. H. 1979. Review of the book "Symptoms of virus diseases in plants" by L. Bos. HortScience 14: 558.
- Converse, R. H. and A. B. Bartlett. 1979. Occurrence of viruses in some wild Rubus and Rosa species in Oregon. Plant Dis. Reptr. 63: 441-444.
- Clarke, R. G., R. H. Converse, and M. Kojima. 1980. Enzyme-linked immunosorbent assay to detect potato leaf roll virus in potato tubers and viruliferous aphids. Plant Disease Rept. 64: 43-45.
- Lagerstedt, H. B. 1979. Tree kill trials with glyphosate and other herbicides. Proc. West. Soc. Weed Sci. 32: 100-101.
- Lagerstedt, H. B. 1979. Filberts. Chapter in: Nut Tree Culture in North America. R. A. Jaynes, Ed. No. Nut Growers Assoc., Inc. pp. 128-147.
- Lagerstedt, H. B. 1979. Propagation - Seed, Grafting, Budding. Chapter in: Nut Tree Culture in North America. R. A. Jaynes, Ed. No. Nut Growers Assoc., Inc. pp. 240-271.
- Lagerstedt, H. B. 1979. New and old pesticides registered for use on filberts. Proc. Nut Growers Soc. Ore., Wash., & B. C. 64: 56-60.
- Kelley, J. R. and H. B. Lagerstedt. 1979. Screening plant growth regulators to improve filbert nut set. Proc. Nut Growers Soc. Ore., Wash. & B.C. 64: 44-51.
- Haunold, A., and G. B. Nickerson. Hop yield stimulation by triploid males under field conditions. Crop Science 19: 27-31. 1979.
- Haunold, A., C. E. Horner, and G. B. Nickerson. 1979. Registration of eight triploid hop pollinators. Crop Science 19: 753-754.
- Nickerson, G. B. and S. T. Likens. 1979. Hop storage index. Am. Soc. Brewing Chemists Journal 37: 184-187.
- Roberts, D. D. 1979. Mint breeding and genetic research. Oregon Essential Oil Growers League, Proc. 30th annual meeting. pp. 7-8.
- Roberts, D. D. 1979. Programs to reach yield potential for mint. Irrigated Agriculture Fertilizer Conf. Proc. pp. 6-7.

Scott, D. H., F. J. Lawrence, and A. D. Draper. 1979. Strawberry varieties in the United States. USDA FB 1043, 26 pp.

Lawrence, F. J. 1979. Growing raspberries. USDA FB 1043, 15 pp.

Lagerstedt, H. B. Hardiness in filberts and walnuts. Ann. Rept. No. Nut Gr. Assoc. 69: 118-121.

#### Brownwood, Texas

Madden, G. D. Pecans. Nut Tree Culture in North America. Ed. Richard A. Jaynes. Pub. by Northern Nut Gr. Assoc., Inc. Chapter 3, Pecans. 13-34. 1979.

Madden, G. C. 1979. USDA pecan varieties and selections. Texas Pecan Orchard Mgmt. Handbook. 28-32.

#### Prosser, Washington

Romanko, R. R., J. Jaeger, G. B. Nickerson, and C. E. Zimmerman. 1979. Registration of Galena hop. Crop Sci. 19: 563.

#### Wenatchee, Washington

Parish, C. L. 1979. X-disease - distribution and symptoms. Proc. Natl. Peach Council 38: 54-55.

Parish, C. L. 1979. X-disease - management and chemotherapy. Proc. Natl. Peach Council 38: 65.

Raese, J. T., C. F. Pierson, and D. G. Richardson. 1979. Alfalfa greening of Anjou pear. HortSci. 14: 232-234.

Raese, J. T. 1979. Mineral content of Anjou pear fruit affected with green blotch. Proc. Inter. Soc. Hort. Sci., Conf. Mineral Nutrition and Fruit Quality of Temperate Zone Fruit Trees. Canterbury, United Kingdom.

Williams, M. W. 1979. Chemical thinning of apples. Chapter in Horticultural Reviews, Vol. 1: 272-302.

#### Kearneysville, West Virginia

Aldwinckle, H. S. and T. van der Zwet. 1979. Recent progress in breeding for fire blight resistance in apples and pears in North America. European and Mediter. Plant Protection Organ. Bul. 9(1): 27-34.



van der Zwet, T, R. C. Blake, and R. H. Zimmerman. 1979. The USDA pear breeding program II. Seedling evaluation. Fruit Var. Journal 33(2):57-65.

van der Zwet, T. and H. L. Keil. 1979. Fire blight - a bacterial disease of rosaceous plants. USDA Handbook 510, 200 pp., illus.

Fogle, H. W. 1979. Identification of tree fruit species and clones by pollen ultrastructure. Proc. IV Internal. Pollination Symposium: Maryland Misc. Publ 1:475.

Fogle, H. W. 1979. An overview of peach breeding and genetics research. Proc. National Peach Council 38: 14-21.

Fogle, H. W. 1980. European fruit germplasm inventory. Proc. Eucarpia Fruit Section Symposium, Angers, France, Sept. 1979. pp. 307-308.

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## National Research Program 20020

### BREEDING AND PRODUCTION - VEGETABLES

This National Research Program involves research in breeding and production of vegetables to develop new and improved genetic and cultural methods that will result in lowering costs of vegetables and potatoes to consumers and increasing efficiency of production of these crops to growers, small acreage farmers, and homeowners. Geneticists, plant pathologists, plant physiologists, and horticulturists (both Federal and State) work in a team approach to evaluate and improve vegetables and vegetable cultural methods.

The research is conducted at 17 locations in 13 States in both Federal and State stations where SEA/AR scientists usually work as a team with State scientists.

In 1979, vegetables and potatoes (including dry beans and peas) were harvested from 5.4 M acres with an aggregate value of over \$5 billion.

Technological Objective 1: New and improved genetic populations, breeding lines, and varieties of vegetables that combine improved yield potentials and favored quality characters, including reduced contents of undesirable constituents, with better resistance to pests, tolerance to environmental stress, and adaptation for mechanized culture, harvesting, and handling.

NPS Contact: R. E. Coleman

#### Research Locations:

Palmer, Alaska  
Salinas, California  
Tifton, Georgia  
Aberdeen, Idaho  
Presque Isle, Maine  
Beltsville, Maryland  
East Lansing, Michigan

Corvallis, Oregon  
Mayaguez, Puerto Rico  
Charleston, South Carolina  
Weslaco, Texas  
Prosser, Washington  
Pullman, Washington  
Madison, Wisconsin

#### Examples of Recent Progress:

"Dry" bean varieties make edible pods earlier than snap beans - Palmer, Alaska. "Dry" bean varieties arrived at the edible green pod stage earlier or as early as standard green "snap" beans. This could be significant for areas where the growing season is marginal for snap beans. Like the new sugar snap pea, strings from both can be objectionable.

Alaskan potato clones are the base for new chip factory - Palmer, Alaska.

Potato selections AK 38-2, Denali, and Snowchip were grown for the first time for commercial chip manufacture in Alaska, and the trade has acknowledged through reorder that the chips are good. Potato 34-2 AK was also in commercial production as a new russet-skinned variety for bidding on defense forces contracts.

New Cos lettuce has high quality - Salinas, California. Signal, a high quality cos (romaine) lettuce is released as a cultivar to lettuce breeders and seed growers. It is adapted for culture in the desert Southwest. It is earlier, more uniform, and sweeter than cv. Parris Island. Head shape is blocky and leaf shape is spatulate in comparison to Parris Island.

New cantaloupe has virus resistance - Salinas, California. WMR 29, a high quality cantaloupe breeding line with resistance to watermelon mosaic virus 1 is released to melon breeders and seed growers. It is adapted for culture in the desert southwest. WMR 29 also has tolerance to watermelon mosaic virus 2, tolerance to sulfur, and is segregating for resistance to powdery mildew. It is extremely firm when ripe and should serve as a good breeding line for development of shipping-type cantaloupes.

New potato varieties popular in Maine - Presque Isle, Maine. The high solids, high quality, widely adapted pest-resistant variety Belchip released in 1978 continues to increase in popularity. Seed demand far exceeds the supply, in part, because of its excellent chip quality and high resistance to tuber heat necrosis. BelRus, a medium late maturing, smooth, very high quality russet, resistant to major potato viruses, including tuber net necrosis caused by the potato leaf roll virus, is in major demand in the Northeastern and Midwestern United States. BelRus is expected to complement the Russet Burbank variety in production east of the Rocky Mountains as a fresh market and processing variety. Delta Gold, a yellow-flesh variety, released in 1979, is expected to improve the Northeast potato producers opportunity for seed and table stock export to countries preferring a yellow-flesh potato.

Release of the yellow flesh potato variety Delta Gold - Beltsville, Maryland. Delta Gold is a high solids, yellow flesh, high quality variety that is expected to enhance the certified seed and export potential for the Northeast to the Central, South American, and African countries where yellow-flesh potatoes are preferred.

New processing tomato hybrid looks promising - Beltsville, Maryland. Results of cooperative university, processor, and grower trials of the F<sub>1</sub> hybrid 77B68 indicate that the line is earlier maturing than any presently available processing variety. It yields well, is widely adapted, can be mechanically harvested, and has good fruit quality for canning, whole or product manufacture. Commercial trials will involve approximately 1,000 acres in 1980.

Hybrid lima bean outstanding in yield - Beltsville, Maryland. A hybrid Jackson Wonder type lima bean developed and produced at Beltsville Agricultural Research Center yielded over two tons of fresh shelled beans per acre in a replicated variety test in Delaware. The yield was significantly greater

than that of Jackson Wonder and 35 other varieties or breeding lines in the test.\*

Bean cultivars resistant to Peanut Stunt Virus identified - Beltsville, Maryland. Peanut stunt causes large losses to commercial bean growers, small farmers, and home gardeners in the Middle Atlantic and Southeastern States. Field tests in 1979 confirmed earlier greenhouse screening that identified several bean cultivars as being highly resistant. Breeding for resistance studies have been initiated.

Earworm resistant line for sweet corn identified - Charleston, South Carolina. An earworm resistant sweet corn composite was developed and released to breeders and seed producers. Composite 9E-79, a productive mid-season sweet corn, will provide plant breeders a useful source of germplasm from which superior inbred lines may be extracted. It will also serve as a reservoir for the conservation of valuable sweet corn germplasm.

Pickleworm resistance identified - Charleston, South Carolina. A source of pickleworm resistance has been identified in muskmelon PI 183311. The resistant plants have fewer pickleworm eggs deposited on their leaves and sustain less damage from feeding larvae than commercial cultivars. This source of genetic resistance will provide breeders the material they need to develop resistant cultivars.

Root-knot nematode resistant snap beans on the horizon. Charleston, South Carolina. A reliable method for screening snap beans for resistance to root-knot nematodes was developed and a resistant breeding line was identified that will yield on nematode infested soil comparable to that of most cultivars on uninfested soil. B4175 also has resistance to most strains of rust found in the Southeastern States. Seed were produced and release proceedings have been initiated.

Disease resistance for southernpea identified - Charleston, South Carolina. Results of tests in 1979 indicated that the development of a southernpea with resistance to Cercospora leaf spot is nearing completion. Progeny from the sixth backcross to a popular brown-crowder type performed exceptionally well and lines were selected for the seed increase.

Screening techniques developed for sweet potato weevil resistance - Charleston, South Carolina. Laboratory techniques and field screening procedures were developed for identifying sources of resistance in sweet potato to the sweet potato weevil. Several breeding lines were found with low weevil damage indexes which could lead to a weevil resistant cultivar.

'Footlong' new disease resistant pole bean - Charleston, South Carolina. In a cooperative effort with the Clemson University Coastal Experiment Station, a new pole bean variety was developed. The new variety, named 'Footlong,' has an attractive pod, comparable to 'Kentucky 191' for maturity, and has resistance to Rhizoctonia root rot.



Release of multidisease-resistant cantaloupe germplasm - Weslaco, Texas.

Horticulturally acceptable cantaloupe breeding lines which have combined resistance to the three main leaf diseases of this crop that occur in the U.S. were released. These cantaloupe lines have a complex genetic background from which their resistance is derived. They have been tested for 10 years under severe disease conditions during which they exhibited superior resistance to these 3 fungal diseases without the use of fungicide applications.

Redchief lentil developed and released to growers - Pullman, Washington.

Redchief (formerly RC511) was developed primarily to provide the first red cotyledon lentil for the Palouse region. Formerly all lentils grown in the U.S. had yellow cotyledons and therefore were not acceptable to the substantial foreign red lentil market. Because Redchief opens new markets, production of this new type of lentil should increase dramatically.

Resistance to pea seedborne mosaic virus transferred to dry beans - Pullman, Washington.

Pea seedborne mosaic virus resistance has been transferred to four varieties of dry beans--Garfield, Tracer, Latah, and Alaska. These virus resistant derivatives should be indistinguishable from the original varieties and will provide a needed efficient and reliable method of controlling the disease.

Release of hybrid onions - Madison, Wisconsin. Spartan Banner 80 corrects the fragile seed coat defect in the popular hybrid Spartan Banner and provides pink root resistance in the seed parent to insure more reliable production where pink root is prevalent in seed production areas.

Breeding for good flavor in carrots - Madison, Wisconsin. New laboratory techniques permit the selection of high quality carrot roots from small samples. The remaining portions of the sampled root can then be used for breeding and seed production. Dominance for good flavor, particularly in inbred B6274 and B10138, provides the basis for selecting parents to be used in developing high quality hybrids.

Mild flavored onions developed - Madison, Wisconsin. Three new breeding lines--B826, B5718, and B8155--provide the parents needed to produce high-yielding storage onions with a level of pungency comparable to Sweet Spanish. This development will permit production of mild onions in areas where Sweet Spanish is not adapted.

Use of endosperm balance number (EBN) theory to cross nontuber-bearing and tuber-bearing species of potato - Madison, Wisconsin. The wild Mexican tuber-bearing *Solanum* species, *S. cardiophyllum* was determined to be a 1EBN species. The nontuber-bearing *etuberosum* series species were also found to be 1EBN. *S. cardiophyllum* was successfully crossed with *S. fernandezianum*, a nontuber-bearing species and hybrid progeny have been grown to mature flowering plants. The importance of this work is that the nontuber-bearing *etuberosum* series species have excellent frost resistance, are self compatible, but most important have resistance to several important virus diseases at a level not found among the tuber-bearing *Solanums*. The finding of 1EBN tuber-bearing *Solanum* species makes possible the direct assessing of this valuable germplasm.

Cryogenic storage of Solanum materials appears practical - Madison, Wisconsin. The development of a usable 'optimum' rate cooling procedure of potato shoot tips that allows for high survival in materials tested so far means that cryogenic storage of clonal Solanum materials may someday be used as a routine germplasm preservation procedure.

Technological Objective 2: New and improved cultural and management practices that increase vegetable yields, minimize production losses, improve quality attributes, and conserve and use scarce resources efficiently.

#### Research Locations:

Palmer, Alaska  
Salinas, California  
Tifton, Georgia  
Presque Isle, Maine

Beltsville, Maryland  
East Lansing, Michigan  
Corvallis, Oregon  
Prosser, Washington

#### Examples of Recent Progress:

Fall broadspectrum soil fumigation controls soilborne pests of vegetable transplants - Tifton, Georgia. South Georgia fields produce about \$10 million worth of vegetable transplants for shipments from north Florida to southern Ontario, Canada. Most of this production is concentrated within 40 miles of Tifton, Georgia, and most shipments are to midwestern U.S. and Ontario, Canada. Soilborne pests (parasitic fungi, parasitic nematodes and weeds) control continues to be the major problem of production. Fall broadspectrum soil fumigation at 193 or 326 l/ha of DD-MENCS chiselled and water sealed effectively controlled soilborne pests, improved plant vigor and growth uniformity, and increased marketable transplant yields. Fall fumigation increased pepper and tomato transplant yields significantly.

Ontario and Snowchip potato cultivars highly resistant to bacterial wilt - Tifton, Georgia. Bacterial wilt is a major soilborne disease of many crops in tropical, subtropical, and mild temperate humid regions of the world. These same regions of the world have the highest population growth rate, most of the malnutrition, and the least advances in science and technology. This disease is usually the major limiting factor in potato production in these regions of the world. A combination of soil and plant inoculation has made testing for bacterial wilt resistance possible for potatoes. Ontario was the only cultivar found to be highly resistant to the disease, with only 1% and 8% dead or dying plants in 1978 and 1979, respectively. Based on tuber infection, Ontario and Snowchip were the most resistant, with 9% and 14% infection, respectively, in 1978 and both 4% in 1979. Saco, Green Mountain, and Sebago also showed some resistance.

## CULTIVARS RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
Dry Bean		
Navy (Pea) 'NW-395'	SEA/AR, WA, OR, and ID AES	Common mosaic and curly top virus resistance
Pinto 'NW-590'	SEA/AR, WA, OR, and ID AES	Common mosaic virus resistance
Pinto 'NW-410'	SEA/AR, WA, OR, ID, and CO AES	Common mosaic virus and other disease resistance
Red Mexican 'NW-59' 'NW-63'	SEA/AR, WA, OR, and ID AES	Common mosaic virus and curly top resistance
Black 'Carbon'	SEA/AR and PR AES	Soilborne disease resistance
'B-128'	SEA/AR and PR AES	Multiple disease resistance
'B-190'	SEA/AR and PR AES	Rust resistant
'B-351'	SEA/AR and PR AES	Systemic mosaic resistant
'2B-5-1'	SEA/AR and PR AES	Rust resistant
'MITA-76-R287'	SEA/AR and PR AES	Multiple disease resistance
White 'W-117'	SEA/AR and PR AES	Systemic mosaic resistant
'W-142'	SEA/AR and PR AES	Systemic mosaic resistant
'2W-33-2'	SEA/AR and PR AES	Disease resistance
Light Brown 'Chorro'	SEA/AR and PR AES	Soilborne disease resistance
'Mogote'	SEA/AR and PR AES	Soilborne disease resistance
Lettuce 'Signal'	SEA/AR and CA AES	High quality, marketable heads



# CULTIVARS RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
Onion 'Spartan Banner 80'	SEA/AR and MI AES	Pink-rot resistance
Potato 'Highlat Russet'	SEA/AR and AK AES	Multipurpose russet type

## NONCOMMERCIAL GERMPLASM RELEASED

Cantaloup WMR 29	SEA/AR, CA and AZ AES	Watermelon mosaic virus resistance
AR Hales Best Jumbo	SEA/AR and CA AES	Melon aphid resistance
AR-5	SEA/AR and CA AES	Melon aphid and powdery mildew resistance
W1, W3, W4, W5, W6	SEA/AR	Downy and powdery mildew and leaf blight resistance

## Dry Bean

White MITA 6383	SEA/AR and PR AES	Rust, bacterial blight and soilborne disease resistance
MITA-RSP-1	SEA/AR and PR AES	Rust resistance
Black MITA-RSP-2	SEA/AR and PR AES	Rust resistance
Cream/tan to brown speck MITA-RSP-3	SEA/AR and PR AES	Rust resistance
Tonto brown MITA-RSP-4	SEA/AR and PR AES	Rust resistance
Scarlet Runner (1 to 11)	SEA/AR and PR AES	Multiple disease resistance
Onion MSU 611-1prrrA MSU 611-1prrrB MSU 611 prr	SEA/AR and MI AES	Pink-rot resistance long-day, storage types
ga-c 76	SEA/AR	Amphidiploid, medium bulbing

## Snapbean

BARC-Rust Resistant-1	SEA/AR and WA AES	Rust resistant
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NONCOMMERCIAL GERMPLASM RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
Snapbean		
78 BP-3	SEA/AR and WA AES	Multiple disease resistance
B 4175	SEA/AR and WA AES	Root-knot nematode resistance
Sweet Corn		
Composite 9E-79	SEA/AR	Earworm resistance

## P U B L I C A T I O N S

### Palmer, Alaska

Dearborn, C. H. 1979. Denali: A high dry matter potato with wide adaptation. Amer. Potato Jour. 56(7):373-378.

Dearborn, C. H. 1979. Horticultural limitations and potentials of Alaska's Arctic, particularly the Kobuk River Region. Arctic 32(3):248-262.

Dearborn, C. H. and W. G. Vandre. January 1980 (Revised). Vegetables and fruits for Alaska: Recommended variety list for Southcentral Alaska. Coop. Ext. Serv. Pub. P. 31.

### Salinas, California

Coudriet, D. L., A. N. Kishaba, J. D. McCreight and G. W. Bohn. 1979. Varietal resistance in onions to thrips. J. Econ. Ent. 72:614-615.

Ibrahim, A. M., E. J. Ryder and V. E. Rubatzky. 1979. Annual cropping - a new strategy for growing globe artichoke (Cynara scolymus) in California. HortScience 14:428. (Abstract)

McCreight, J. D. and G. W. Bohn. 1979. Descriptions, genetics and independent assortment of red stem and pale in muskmelon (Cucumis melo L.). J. Amer. Soc. Hort. Sci. 104:721-723.

Principe, J. A. and J. D. McCreight. 1979. A technique for improving fruit set by hand pollination and observations on optimum cultural conditions for fruit set under greenhouse conditions. Cucurbit Gen. Coop. Rept. 2:22.

Ryder, E. J. 1979. 'Salinas' lettuce. HortScience 14:283.

Ryder, E. J. 1979. 'Vanguard 75' lettuce. HortScience 14:284.

Ryder, E. J. 1979. Effects of big vein resistance and temperature on disease incidence and percentage of plants harvested of crisphead lettuce. J. Amer. Soc. Hort. Sci. 104:665-668.

### Tifton, Georgia

Enfinger, J. M., S. M. McCarter and C. A. Jaworski. 1979. Evaluation of chemicals and application methods for control of bacterial wilt. Phytopathology 69:637-640.

Johnson, A. W., S. M. McCarter, C. A. Jaworski, and R. E. Williamson. 1979. Chemical control of nematodes and soil-borne plant pathogenic fungi on cabbage transplants. J. Nematology 11:138-144.

Johnson, A. W., C. A. Jaworski, D. R. Sumner, and R. B. Chalfant. 1979. Effects of film mulch, trickle irrigation, and soil pesticides on nematodes



and yield of polebean. Plant Dis. Repr. 63:360-364.

Johnson, A. W., D. R. Sumner, and C. A. Jaworski. 1979. Effect of film mulch, trickle irrigation, and DD-MENCs on nematodes, fungi, and vegetable yields in a multicrop production system. Phytopathology 69:1172-1175.

Jaworski, C. A., R. E. Webb, R. W. Goth, and S. C. Phatak. 1979. Resistance of potato cultivars to bacterial wilt. Amer. Potato J. 56:467.

Jaworski, C. A., S. C. Phatak, A. W. Johnson, and S. M. McCarter. 1979. Tomato production and soil pest control in relation to width of film mulch and volume of soil fumigated. HortScience 14:121.

Williamson, R. E. and C. A. Jaworski. 1979. Effect of seedling rate, pattern, row position, and clipping on size uniformity of field-grown tomato transplants. J. Amer. Soc. Hort. Sci. 104:368-371.

#### Orono, Maine

Frank, J. A., R. E. Webb and D. R. Douglas. 1979. Evaluation of several USDA potato clones for resistance to early blight. Plant. Dis. Repr. 63:392-394.

Rebois, R. and R. E. Webb. 1979. Reniform nematode resistance in potato cultivars. Amer. Pot. J. 56:313-319.

#### Beltsville, Maryland

McCollum, G. D. 1979. Sterility of successive backcrosses of Raphanobrassica ( $2n=4x=36$ ) with recurrent Brassica oleracea ( $2n=2x=18$ ). Canad. J. Genet. Cytol. 21:479-485.

Meiners, J. P. and H. E. Heggstad. 1979. Evaluation of snap bean cultivars for resistance to ambient oxidants in field plots and to ozone in chambers. Plant Dis. Repr. 63:273-277.

San Antonio, J. P. and A. Peerally. 1979. Growth, primordia formation, and fruiting of 20-2 different strains of Agaricus bitorquis. Mushroom Sc. 10 (Part 1), Proc. X Int. Cong. on Sci. and Cult. of Edible Fungi. pp. 587-594.

San Antonio, J. P. 1979. Stability of spawn stocks of the cultivated mushroom stored for 9 years in liquid nitrogen ( $-160$  to  $-196$  C). Mushroom Sc. 10 (Part 1), Proc. X Int. Cong. on Sci. and Cult. of Edible Fungi. pp. 103-113.

Sanford, L. L. and T. L. Ladd. 1979. Selection for resistance to potato leafhoppers in potatoes. II. Progress after two cycles of phenotypic recurrent selection. Am. Pot. J. 56:541-547.

Sanford, L. L. 1979. Effect of random mating on yield and specific gravity in two Solanum tuberosum spp. tuberosum populations. Am. Pot. J. 56:597-607.

Stoner, A. K. and N. Smith. 1979. Vegetables are appealing if you don't mind the work. 1978 USDA Yearbook of Agriculture. PP. 199-209.

Thomas, C. A. and V. J. Fisher. 1979. Registration of C-171 lima bean germplasm. Crop Sci. 19:419.

Thomas, C. A. and V. J. Fisher. 1979. Registration of F-169 lima bean germplasm. Crop Sci. 19:419.

Webb, R. E. 1979. Inheritance of resistance to watermelon mosaic virus 1 in Cucumis melo L. HortScience 14:265-266.

#### East Lansing, Michigan

Cafati, C. R. and A. W. Saettler. 1979. Transmission of bean common blight bacteria (Xanthomonas phaseoli) in seed of resistant and susceptible genotypes. Ann. Rept. Bean Improv. Coop. 22:42-43.

Cafati, C. R. and A. W. Saettler. 1979. Effect of host genotype on multiplication and distribution of bean common blight bacteria (Xanthomonas phaseoli). Ann. Rept. Bean Improv. Coop. 22:43-45.

Hosfield, G. L. and M. A. Uebersax. 1979. Canning quality evaluations of tropical and domestic dry bean germplasm. Mich. Dry Bean Dig. 3(4):4-9.

Trujilio, G. E. and A. W. Saettler. 1979. Serology and selective enrichment as aids in the detection of Xanthomonas blight bacteria. Ann. Rept. Bean Improvement Coop. 22:44-46.

#### Corvallis, Oregon

Hampton, R. O. and S. W. Braverman. 1979. Occurrence of pea seedborne mosaic virus and new virus-immune germplasm in the Plant Introduction Collection of Pisum sativum. Plant Dis. Reptr. 63:95-99.

#### Charleston, South Carolina

Cuthbert, F. P., Jr. and R. L. Fery. 1979. Value of plant resistance for reducing cowpea curculio damage to the southernpea (Vigna unguiculata (L.) Walp.). J. Amer. Soc. Hort. Sci. 104:199-201.

Jones, Alfred, J. M. Schalk and P. D. Dukes. 1979. Heritability estimates for resistances in sweet potato to soil insects. J. Amer. Soc. Hort. Sci. 104:424-426.

Fery, R. L. and F. P. Cuthbert, Jr. 1979. Measurement of pod-wall resistance to the cowpea curculio in the southernpea (Vigna unguiculata (L.) Walp.). HortScience 14:29-30.

Fery, R. L., F. P. Cuthbert, Jr., and W. D. Perkins. 1979. Artificial infestation of the tomato with eggs of the tomato fruitworm. J. Econ.

Entomol. 72:392-394.

Fery, R. L. and P. D. Dukes. 1979. Genetics of root knot resistance in the southernpea (Vigna unguiculata (L.) Walp.). HortScience 14:406 (Abstract).

Schalk, J. M., C. S. Creighton, R. L. Fery, W. R. Sitterly, B. W. Davis, T. L. McFadden, and Augustine Day. 1979. Reflective film mulches influence insect control and yield in vegetables. J. Amer. Soc. Hort. Sci. 104:759-762.

Rolston, L. H., Thomas Barlow, Teme Hernandez, S. S. Nilakhe, and Alfred Jones. 1979. Field evaluation of breeding lines and cultivars of sweet potato for resistance to the sweet potato weevil. HortScience 14:634-635.

Schalk, J. M., A. Jones and C. S. Creighton. 1979. Artificial infestation of sweet potato with banded cucumber beetle eggs. HortScience 14:740-741.

Wann, E. V. 1980. Seed vigor and respiration of maize kernels with different endosperm genotypes. J. Amer. Soc. Hort. Sci. 105:31-34.

Wyatt, J. E. and George Fassuliotis. 1979. Methods for screening snap beans for resistance to root-knot nematodes. HortScience 14:27-28.

Prosser, Washington

Burke, D. W. 1979. Bibliography of Plant Pathology and Entomology. Ann. Rep. Bean Improv. Coop. 22:123-141.

Drake, S. R., J. W. Nelson and T. K. Toyama. 1979. The influence of cultivar on drained weight and can corrosion in processed apricots. J. Amer. Soc. Hort. Sci. 103(3):49-51.

Drake, S. R., J. W. Nelson, J. R. Powers, and R. E. Early. 1978. Fresh and processed asparagus quality as influenced by field grade. J. Food Quality 2:149-155.

Drake, S. R., E. L. Proebsting, Jr. and J. W. Nelson. 1979. Influence of growth regulators on the quality of fresh and processed 'Bing' cherries. J. Food Sci. 43:1695-1697.

Drake, S. R. and J. W. Nelson. 1979. A comparison of three methods of maturity determination in sweet corn. HortScience 14(4):546-548.

Drake, S. R., J. W. Nelson and J. R. Powers. 1979. The influence of controlled atmosphere storage and processing conditions on the quality of applesauce from 'Golden Delicious' apples. J. Amer. Soc. Hort. Sci. 104(1):68-70.

Hagel, G. T. and D. W. Burke. 1979. Resistance in dry beans to seedcorn maggot. Ann. Rep. Bean Improv. Coop. 22:63.

Haglund, W. A. and J. M. Kraft. 1979. Fusarium oxysporum f. sp. pisi,



Race 6: Occurrence and distribution. *Phytopathology* 69:818-820.

Kraft, J. M. and R. A. Giles. 1979. Increasing green pea yields with root-rot resistance and subsoiling. *In* *Soil-Borne Plant Pathogens*. Book edited by B. Schippers and W. Gams. Academic Press, New York. Chap. 35.

Martin, M. W. 1979. Breeding for potato disease resistance. *Proc. Wash. State Potato Conf.* 18:95-100.

Ogg, A. G. and M. W. Martin. 1979. Effects of herbicides on weed control and on growth and yield of direct-seeded tomatoes. *Wash. State Univ. Ext. Bull.* 870, 5 pp.

Ogg, A. G., Jr. and S. Drake. 1979. Effects of herbicides on weeds and sweetcorn (*Zea mays*) grown on coarse-textured soils. *Weed Sci.* 27(6):608-611.

Pike, K. S. and S. R. Drake. 1979. Corn (sweet): *Zea mays* 'Jubilee' corn earworm: *Heliothis zea* Boddie. *Insecticide and Acaricide Tests* 4:76.

Powers, Jr. R., S. R. Drake and J. W. Nelson. 1979. Comparison of yellow apple cultivars for applesauce quality. *Wash. State Univ. Bull.* 868, 5 pp.

Silbernagel, M. J. 1979. Release of multiple disease resistant germplasm. *Ann. Rep. Bean Improv. Coop.* 22:37-41.

Thomas, P. E. and G. I. Mink. 1979. Beet curly top virus. *CMI/AAB Descriptions of Plant Viruses* No. 210, 6 pp.

#### Pullman, Washington

Wilson, V. E. and L. W. Hudson. 1979. Inheritance of lentil seedcoat mottle. *J. of Hered.* 70:83-84.

#### Madison, Wisconsin

Landeo, J. A. and R. E. Hanneman, Jr. 1979. Crossability of *Solanum tuberosum* Group Andigena haploids. *Am. Potato J.* 56:427-434.

Ruhde, R. W. and R. E. Hanneman, Jr. 1979. Haploid extraction in the cultivar "Russet Burbank." *Am. Potato J.* 56:587-589.

Sanford, J. C. and R. E. Hanneman, Jr. 1979. Reciprocal differences in the photoperiod reaction of hybrid populations in *Solanum tuberosum*. *Am. Potato J.* 56:531-540.

Simon, P. W. and C. E. Peterson. 1980. Genetic and environmental components of carrot culinary and nutritive value. *Acta Horticulturae* 93.

Tolla, G. E. and C. E. Peterson. 1979. Comparison of gibberellin A<sub>4</sub>/A<sub>7</sub> and silver nitrate for induction of staminate flowers in a gynoeceious cucumber line. *HortScience* 14(4):542-544.

NRP 20020 - VEGETABLE CROPS

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## National Research Program 20030

### BREEDING AND PRODUCTION - FLORIST AND NURSERY CROPS

This National Research Program deals with multidisciplinary research to develop new technology for improving productivity and increasing efficiency in the production of florist and nursery crops to enhance urban and rural environments. This need for new knowledge makes it essential to provide research results on selecting, improving, protecting, maintaining, and cultivating plants for urban and rural home, landscape, and special purpose plantings such as parks, roadside, and shopping centers.

Florist and nursery crops fulfill a social as well as an agricultural need. They affect human feelings and attitudes and greatly enhance human surroundings. Green plants and flowering plants are being used increasingly in and around homes, offices, and public buildings. The retail value of foliage and pot plants is estimated at over \$1 billion annually. The growth in the bedding plant industry in the last few years is probably unexcelled by any other agricultural commodity.

The USDA research program in Florist and Nursery Crop Production Practices is located at three primary centers: Washington, D.C.-Beltsville, Maryland; Delaware, Ohio; and Corvallis, Oregon. These programs are located at Federal and State research stations where SEA/AR scientists work closely with State scientists and closely complement research activities in State programs.

Technological Objective 1: New and improved genetic populations, breeding lines, and varieties of florist and nursery crops that combine improved and favored quality characters, with better resistance to pests, tolerance to environmental stress, and adaptation for mechanized culture, harvesting, and handling.

NPS Contact: R. E. Coleman

#### Research Locations:

Washington, D.C.  
Beltsville, Maryland  
Mandan, North Dakota  
Delaware, Ohio

#### Examples of Recent Progress:

New viburnum cultivar introduced - National Arboretum, Washington, D.C.  
Viburnum plicatum var. tomentosum 'Shasta' has been named and introduced. 'Shasta,' which has a strongly horizontal growth habit and a mature height of 1.8 m. and width of 3.6 m., produces abundant, large inflorescences with



sterile marginal florets that are a third larger than other cultivars. The plant, which is hardy to Zone 5, is spectacular with masses of white inflorescences in May, abundant scarlet fruit in late July and August, and intense plum-colored foliage for an extended period in autumn.

Mildew resistant hybrid lagerstroemia cultivars introduced - National Arboretum, Washington, D.C. Mildew resistance has been combined with elite horticultural characteristics in two interspecific hybrids of L. indica x L. fauriei, 'Muskogee' and 'Natchez.' 'Muskogee' is a multiple-stemmed large shrub or small tree with medium brown exfoliating bark that in 11 years has grown to a height of 7.2 m. and breadth of 3.6 m. The heavy textured, dark green leaves, which turn good reds and yellows in the autumn, are mildew resistant under field conditions. The light lavender flowers open in early August and continue with scattered recurrent bloom. 'Natchez' is a multiple-stemmed large shrub or small tree that in 11 years has grown to a height of 6.6 m. and width of 3.6 m. The exfoliating, dark brown bark of the trunks is more spectacular than that of the parent species, L. fauriei, and this characteristic alone warrants growing this plant. The glossy, dark green leaves have been mildew resistant under field conditions. Abundant white flowers are produced in early July and recurrent bloom continues for more than 2 months. Both cultivars are hardy to Zone 7b. These interspecific hybrids, which combine disease resistance with elite horticultural characteristics, are adaptable for many landscape uses.

New botanical collections enhance National Arboretum - Washington, D.C. Living collections were enhanced by the addition of the Smith Pine Collection comprising 59 plants of 18 species and several cultivars. Distribution to domestic and foreign cooperators included 9,590 plants; 3,504 vegetative propagations, and 4,113 packets of seeds. Public information and educational programs reached 27,200 individuals through correspondence, garden tours, lectures, exhibits, and publications.

New green ash tree released - Mandan, North Dakota. A new green ash tree, 'Cardan,' has been released cooperatively by the USDA-Soil Conservation Service and the USDA-Science and Education Administration. The tree was developed at SEA's Northern Great Plains Research Center, Mandan, and tested by SCS's Plant Material Center, Bismarck, and at several other sites in the Northern Great Plains. 'Cardan' was developed for use in windbreaks, wildlife habitat, and strip mine reclamation. The release of 'Cardan' marks the first time a green ash cultivar has been released for use in conservation plantings.

Technological Objective 2: New and improved cultural and management practices that increase florist and nursery crops yield, minimize production losses, improve quality attributes, and conserve and use scarce resources efficiently.

#### Research Locations:

Tifton, Georgia  
Beltsville, Maryland  
Delaware, Ohio

Corvallis, Oregon  
Puyallup, Washington

#### Examples of Recent Progress:

Use of anthocyanin peonidin from 'Heavenly Blue' morning glory flower as a stable food and beverage color additive - Beltsville, Maryland. Public Law patent #4,172,902 was issued to Asen, Stewart, and Norris (held by USDA) for the use of the anthocyanin peonidin 3-(dicaffeoyl-glycosylglucoside)-5-glucoside as a stable food and beverage color additive. It is a replacement for the banned red dyes #2 and #4.

The role of benzimidazole-tolerant isolates of Dutch elm disease in chemical control - Delaware, Ohio. Benzimidazole fungicides are currently the only effective and registered chemical control for Dutch elm disease. Our research on the nature and occurrence of chemical tolerance in C. ulmi has established the presence of tolerance in nature in the absence of chemical selection force, the ability to select for tolerant strains from a sensitive population, the comparable aggressiveness of tolerant and sensitive strains, the lack of disease control by the registered concentration of fungicides or even five times the registered concentration in elms inoculated with a tolerant isolate, and finally the stable nature of tolerance in vivo and in vitro. This research is significant in pointing to the potential break down of our only chemical means of controlling DED.

Fungicide volatilization controls powdery mildew - Corvallis, Oregon. Powdery mildew is the most costly and troublesome disease of cut rose production and is presently only partially controlled by repeated and consistent fungicidal sprays. The discovery of the total protection and even eradication of the disease in a commercial greenhouse by volatilizing fungicides applied to a hot pan or heating pipes offers real hope for control in the future. This system has been effective with materials applied in small amounts in a greenhouse closed up for 4-6 hours during the night, making application safe, economical, and remarkably less polluting, yet giving complete coverage and control. The volatilization principle has application to many other greenhouse foliage disease situations.

Weevil feeding preference in rhododendron - Puyallup, Washington. The problem of weevil feeding damage on rhododendrons is of major significance not only to the nursery industry but also to the multitude of home gardeners that experience great loss due to these pests. Weevils feed on certain rhododendron species and not on others. For example, F. thompsonii is susceptible while R. williamsianum is resistant to weevil feeding. Results have indicated some morphological differences and that susceptible species form extractable attractants (of which sucrose is one) which, if added to resistant leaves or cellulose acetate filter discs, make them palatable to feeding weevils. Resistant species have extractable inhibitors. This knowledge is important in developing modified pest control strategies which might be good alternatives to pesticides as well as selection for resistant hybrids.

Stress ethylene - Corvallis, Oregon. Ethylene is evolved by plants subjected to environmental stresses including air pollution and fungal pathogens, often before visible signs of the disease, other stress damage, or a growth reduction. In the case of disease, ethylene is evolved within hours after penetration of the fungal pathogen. The pathogen, Cylindrocladium, is able to produce ethylene in vitro only in the presence of methionine, a normal constituent of plant tissue. Apparently a light sensitive precursor is involved suggesting a microbial ethylene synthesis pathway never before described.

Accumulated photosynthate does not suppress photosynthetic rate - Corvallis, Oregon. The possible inhibition of photosynthesis by its products is a long standing question of importance especially to breeders selecting for high photosynthetic rates of crop plants if photosynthesis were self-limiting by its products. Plants forced to accumulate starch up to 50% of the leaf dry weight under continuous light did not show a significant decline in photosynthetic rate indicating the lack of a feedback mechanism.

Technological Objective 3: To enhance environmental quality by reducing pollution and improving man's surroundings.

#### Research Locations:

Beltsville, Maryland  
Delaware, Ohio

Corvallis, Oregon

#### Examples of Recent Progress:

Air pollutants affect tree growth - Delaware, Ohio. First published microscopic evidence of a definitive correlation relating air pollution injury between laboratory and field data. This information will permit plant disease diagnosticians to define and characterize injury resulting from specific abiotic agents. A combination of stress factors (i.e., air pollution and chemical growth regulators) was found to influence tree growth to a greater degree than the same factors applied singly. These findings emphasize the importance of studying the interaction of multiple stress factors as they influence the growth and survival of urban trees.

#### VARIETIES RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
Dianthus 'Smokey'	SEA/AR and NE AES	Low temperature hardiness and disease resistance
Rose 'Spotless Pink'	SEA/AR	Blackspot resistance
'Spotless Gold'	SEA/AR	Blackspot resistance
'Spotless Yellow'	SEA/AR	Blackspot resistance
Green Ash 'Cardan'	SEA/AR and SCS	Conservation and amenity



# PUBLICATIONS

## Washington, D. C.

- Ackerman, W. L. 1979. What's new in camellias? Amer. Cam. J. 34(1):1-4.
- Ackerman, W. L. and Margot Williams. 1979. Does treatment of camellia flowers with growth regulators before pollination assist in fertilization? Amer. Cam. J. 34(4):38-39.
- Egolf, Donald R. 1978. 'Navaho' and 'Teton' - New National Arboretum pyracantha cultivars. Balls & Burlaps, Washington State Nurserymen's Assn. 29(10):5.
- Egolf, Donald R. 1978. 'Navaho' and 'Teton'--New pyracantha cultivars. Amer. Nurseryman CXLVIII(9):7, 42, 44, 46.
- Egolf, Donald R. 1978. Two new pyracantha cultivars produced by National Arboretum. Pacific Coast Nurseryman and Garden Supply Dealer 37(11):8, 10.
- Egolf, Donald R. 1979. 'Shasta' viburnum. HortScience 14(1):78-79.
- Egolf, Donald R. 1979. National Arboretum introduces new viburnum 'Shasta.' Southern Florist & Nurseryman 91(51):22-23, 30-31.
- Egolf, Donald R. 1979. New viburnum cultivar introduced. Amer. Nurseryman CXLIV(7):16-17, 38, 40, 44.
- Feathers, D. L. and M. H. Brown (Editors). 1978. The camellia. The R. L. Bryan Co., Columbia, SC. 476 pp.
- Santamour, F. S., Jr. 1979. Resistance of Himalayan small-leaved elm to Dutch elm disease. Jour. Arboric. 5:110-112.
- Santamour, F. S., Jr. 1979. Attempted intersubgeneric hybridization with Magnolia virginiana: An exercise in failure. Newsl. Amer. Magnol. Soc. 15(1):22-23.
- Santamour, F. S., Jr. and K. E. Clausen. 1979. Testing the Japanese white birch. Amer. Nurseryman 149(1):15, 82, 84, 86, 88-90, 92-93.
- Santamour, F. S., Jr. 1979. Intersubgeneric hybridization between Magnolia grandiflora and M. acuminata. Newsl. Amer. Magnol. Soc. 15(2): 11-13.
- Santamour, F. S., Jr. 1979. Root hardiness of green ash seedlings from different provenances. Jour. Arboric. 5:276-279.
- Santamour, F. S., Jr. 1979. Inheritance of wound compartmentalization in soft maples. Jour. Arboric. 5:220-225.

Santamour, F. S., Jr. 1979. Plant breeding for resistance. Gardening Without Pests. Hndbk. Brooklyn Bot. Gard. Record, Plants and Gardens 35(2):20-23.

Tifton, Georgia

Gill, D. L. 1979. 'Union' mimosa. HortScience 14(5):644.

Gill, D. L. 1979. Powdery mildew and Cylindrocladium attack Leucothoe axillaris. Plant Dis. Reptr. 63:358-359.

Storey, J. Benton, Pat N. Westfall, and Morris W. Smith. 1979. Why do pecans need zinc? The Pecan Quarterly 13(2):3-9.

Smith, M. W., J. B. Storey, and P. N. Westfall. 1979. The influence of two methods of foliar application of zinc and adjuvant solutions on leaflet zinc concentration in pecan trees. HortScience 14(6):718-719.

Beltsville, Maryland

Arisumi, T. 1980. Chromosome numbers and comparative breeding behavior of certain Impatiens from Africa, India, and New Guinea. Amer. Soc. Hort. Sci. 105:99-102.

Brown, J. D., H. M. Cathey, J. H. Bennett, and R. W. Thimijan. 1979. Effect of light quality and temperature on Fe<sup>3+</sup> reduction and chlorophyll concentration in plants. Agron. J. 71:1015-1021.

Cathey, H. M. 1979. What's on down the road. Florist's Rev. 164(4263):40, 80-81.

Cathey, H. M. 1979. A survey of literature published by the American Society for Horticultural Science. Florist's Rev. 164(4261):27-29, 67-69.

Cathey, H. M. 1979. Flowers and foliage - 75 years of papers published by ASHS. HortScience 14(3):369-372.

Cathey, H. M. and L. E. Campbell. 1979. Relative efficiency of high- and low-pressure sodium and incandescent filament lamps used to supplement natural winter light in greenhouses. J. Amer. Soc. Hort. Sci. 104(6):812-825.

Locke, J. C., G. C. Papavizas, and J. A. Lewis. 1979. Seed treatment with fungicides for the control of Pythium seed rot of peas. Plant Dis. Reptr. 63:725-728.

Papavizas, G. C., F. W. Schwenk, J. C. Locke, and J. A. Lewis. 1979. Systemic fungicides for controlling Phytophthora root rot and damping-off of soybean. Plant Dis. Reptr. 63:708-712.

Semeniuk, P. and R. N. Stewart. 1979. Seasonal effect of UV-B radiation on Poinsettia cultivars. J. Amer. Soc. Hort. Sci. 104(2):246-248.

Semeniuk, P. and R. N. Stewart. 1979. Comparative sensitivity of cultivars of *Coleus* to increased UV-B radiation. *J. Amer. Soc. Hort. Sci.* 104(4):471-474.

Semeniuk, P. 1980. 'Spotless Gold,' 'Spotless Yellow,' and 'Spotless Pink' rose: blackspot resistant breeding lines. *HortScience* 14(6):764-765.

Shepherd, R. J. and R. H. Lawson. 1980. Diagnosis of caulimoviruses. In *Comparative Diagnosis of Viral Diseases*, Vol. IV, Insect and Plant Viruses (E. Kurstak and K. Maramorosch, Eds.).

Stewart, R. N., S. Asen, D. R. Massie, and K. H. Norris. 1979. The identification of *Poinsettia* cultivars by high pressure liquid chromatographic analysis of their anthocyanin content. *Biochem. Syst. Ecol.* 7:281-287.

#### Mandan, North Dakota

Frank, A. B. 1979. Crown pruning single-row field windbreaks. *Proc. of Windbreak Management Workshop*, Great Plains Agricultural Council 92:113-119.

#### Delaware, Ohio

Dochinger, L. S. and A. M. Townsend. 1979. Effects of roadside deicer salts and ozone on red maple progenies. *Environ. Pollution* 19:229-237.

Domir, S. C. 1979. Tree tissue culture for growth regulators. *Proc. of the Symposium on Systemic Chemical Treatments in Tissue Culture*. Michigan State Univ. Braun-Brumfield, Inc., Ann Arbor, MI. 357 pp.

Krause, C. R. and K. F. Jensen. 1979. Surface changes on hybrid poplar leaves exposed to ozone and sulfur dioxide. *Proc. SEM-79*, II:75-78, 737-738.

Roberts, B. R., D. E. Wuertz, G. K. Brown, and W. F. Kwolek. 1979. Controlling sprout growth in shade trees by truck injection. *J. Amer. Soc. Hort. Sci.* 104:883-887.

Schreiber, L. R. 1978. Tolerance of *Ceratocystis ulmi* to benzimidazole fungicides and its impact on the control of Dutch elm disease. *Proc. of the Symposium on Systemic Chemical Treatments in Tree Culture*. Michigan State Univ. Braun-Brumfield, Inc., Ann Arbor, MI. 357 pp.

Townsend, A. M. 1979. Influence of specific combining ability and sex of gametes on transmission of *Ceratocystis ulmi* resistance in *Ulmus*. *Phytopathology* 69:643-645.

Townsend, A. M. 1979. Trials of rooting red maples from cuttings. *The Metrian* 79(2):5-6.

Townsend, A. M., J. W. Wright, W. F. Kwolek, W. F. Beineke, D. T. Lester, C. A. Mohn, and A. F. Dodge. 1979. Geographic variation in young red maple grown in North Central United States. *Silvae Genetica* 28:33-36.



Townsend, A. M. and D. P. Worley. 1979. Firewood gardens: a renewable energy source. The Buckeye Arborist 10:2-4.

Townsend, A. M. 1979. An analysis of red maple characteristics. Amer. Nurseryman 150:12-13, 66, 68, 70.

Ufferman, D. G., B. R. Roberts, G. K. Brown, S. R. Carr, and W. F. Kwolek. 1979. Regrowth control by injection of growth regulators in seedlings of four tree species. HortScience 14:749-751.

Ufferman, D. G., B. R. Roberts, G. K. Brown, and S. R. Carr. 1979. Greenhouse studies of chemical regrowth control. Proc. Symposium on Systemic Chemical Treatments in Tree Culture. pp. 117-125. Braun-Brumfield, Inc. 357 p.

#### Corvallis, Oregon

Baker, K. F. and R. G. Linderman. 1979. Unique features of the pathology of ornamental plants. Ann. Rev. Phytopathology 17:253-277.

Bristow, P. E., R. P. Doss, and R. L. Campbell. 1979. A membrane filter bioassay for studying phagostimulatory materials in leaf extracts. Ann. Entomol. Soc. Amer. 72:16-18.

Doss, R., R. Byther, and W. Vassey. 1979. Foliar fertilization of flower bulb crops -- A trial and some thoughts. Ornamentals Northwest 3(4):11-13.

Doss, R. P. 1979. The basis of obscure root weevil resistance in Rhododendron -- some thoughts on the reasons for investigating the resistance of plants to insects. Ornamentals Northwest 3(5):24-27.

Doss, R. P. 1979. Some aspects of daughter bulb growth and development and apical dominance in bulbous Iris. Plant & Cell Physiol. 20:387-395.

Doss, R. P. and J. K. Christian. 1979. Relationships between bulb size, apex size and flowering in bulbous Iris, cv. Ideal. Physiol. Plant. 45: 215-218.

Doss, R. P., J. K. Christian, and J. M. Langager. 1979. Calcium deficiency and the occurrence of topple disorder in bulbous Iris. Can. J. Plant Sci. 59:185-190.

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## National Research Program 20040

### BREEDING AND PRODUCTION - CORN, SORGHUM AND MILLETS

This program is part of the USDA-SEA-AR Mission 2 - Agricultural Production Efficiency with the goal of producing new knowledge and improved germplasm to increase grain productivity. These important feed grains (see NRP 20100 for forage aspects of these commodities) are of major significance for both domestic and export utilization as food, feed and industrial use. To a lesser degree the program contributes to Mission 3 - Agricultural Marketing and Distribution and Mission 10 - Foreign Agricultural Development. The program is organized under two technological objectives.

NPS Contact: L. W. Briggles (Temporary)

#### Research Locations:

Gainesville, Florida  
Tifton, Georgia  
Manhattan, Kansas  
Urbana, Illinois  
West Lafayette, Indiana  
Ames, Iowa  
Beltsville, Maryland  
Mississippi State, Mississippi  
Columbia, Missouri  
Lincoln, Nebraska  
Raleigh, North Carolina  
Wooster, Ohio  
Brookings, South Dakota  
College Station, Texas  
Mayaguez, Puerto Rico  
Kenya, East Africa

Technological Objective 1: New and improved genetic populations, breeding lines, and hybrids of corn, sorghum and millets that combine improved yield potentials and favored quality characters, including reduced contents of undesirable constituents, with better resistance to pests, tolerance to environmental stress, and adaptation for mechanized culture, harvesting, and handling. Develop basic genetic, cyto-genetic, physiologic, and biochemical knowledge necessary to accomplish these goals.



## Examples of Recent Progress:

### Corn:

Fast dividing cell suspension culture established in maize - Gainesville, Florida. Protoplasts are routinely obtained from this line. Culture conditions for these protoplasts have been developed which result in cell wall formation, sustained cell divisions, and eventually callus formation. This development should advance research on somatic hybridization and related studies at the cellular levels leading to better genetic characterization of cytoplasmic organelles.

Corn earworm growth retardant isolated from corn silks - Tifton, Georgia. Maysin, a flavone glycoside that retards growth of corn earworm larvae, has been isolated from silks. The research was cooperative among scientists in California, Missouri, and Georgia. Tests reveal that certain genotypes contain more maysin than others. Locations and planting dates have an effect on levels of maysin. Content of maysin tends to decline as silks age, especially in genotypes with high initial maysin content.

Two new yellow sweet corn inbred lines released - Tifton, Georgia. Yellow sweet corn lines which are close counterparts of previously released white lines, were released in 1979. These lines, in hybrid combination, have more resistance to corn earworm injury than commonly grown Bantam hybrids and others.

New methods developed for improved analysis of glutelins by gel electrophoresis - Urbana, Illinois. The combined glutelin fraction makes up a large part of the total corn endosperm protein, and possesses a good amino acid composition. Now it will be possible to determine which of the many glutelin proteins are responsible for the increased size of this fraction in high lysine mutants. These methods should be useful in screening for hybrids with improved nutritional quality.

Potential new product from corn refining - Urbana, Illinois. In recent years, soybeans have been the sole source of commercial lecithin in the U.S. When a commercially prepared corn lecithin sample was compared to soybean lecithin, differences were observed in the proportions of lipids and in fatty acid compositions. Corn lecithin had only 1% triunsaturated fatty acid; soybeans had 7%, which would make soybean lecithin more likely to become rancid. Differences between corn and soybean lecithins may provide opportunity for an alternate corn product with useful properties, or perhaps processing conditions could be changed to produce a corn lecithin with selected properties.

Procedures developed for isolating and quantifying host-specific toxin produced by *Helminthosporium carbonum* (leaf spot of corn) - West Lafayette, Indiana. Using high performance liquid chromatography, it was found that conidia produce the toxic peptide during germination. Results are consistent with the concept that the toxin is a determinant of pathogenicity on corn.

Three populations released for use in corn breeding programs - Ames, Iowa. BSAAo<sub>2</sub>(S)C1, is an improved opaque - 2 version of Iowa Synthetic AA (BSAA). One cycle of S<sub>1</sub> recurrent selection was completed for yield, percent protein, percent lysine, and other agronomic traits. BSSAAo<sub>2</sub>(S)C1 is a genetically broad-based population of AES800 maturity that should be a useful breeding population for programs that include breeding for improved protein quality. BS13(S)C1, and BS16 are improved breeding populations useful for extraction of inbred lines. Lines extracted from BS13(S)C1 have good heterosis and combining ability with MO17 and other lines of Lancaster Surecrop origin. BS16 is an adapted strain of Eto composite from Colombia, SA, which has good combining ability with other tropical varieties, and is of Corn Belt maturity.

Model developed to evaluate response in long-term selection programs - Ames, Iowa. Changes in the mean of selected populations and their crosses were found to be a function of inbreeding depression and changes due to alleles with additive effects. Analyses showed that half-sib and S<sub>1</sub> selection increased frequencies of alleles with additive effects and S<sub>1</sub> selection was more effective than half-sib selection. Estimates of rate of inbreeding depression were the same for S<sub>1</sub> and half-sib selection. These analyses indicate that additive effects are primarily emphasized in selection, and that effective population size is important for continued response to selection.

Genetic stock with resistance to first and second broods of European corn borer released - Ames, Iowa. B86 has good resistance to both broods and should be useful in those breeding programs where resistance to both broods is desired.

Inbred line released with higher level of resistance to leaf feeding by southwestern corn borer and fall army worm - Mississippi State, Mississippi. The new inbred line has a higher level of resistance to both the southwestern corn borer and the fall army worm than Mp496 (previously released resistant inbred line), and has resistance to southern corn rust.

Slow rusting characteristic observed in corn - Mississippi State, Mississippi. Southern corn rust infects lower leaves of plants from different planting dates at about the same time. However, of 15 genotypes tested in the field from one planting date, some showed definite slow rusting--expressed through smaller pustule size or longer latent period from inoculation to pustule rupture.

New corn kernel breakage tester increases characterization of genotype - Columbia, Missouri. Equipment was developed, using an impeller type impactor, which measures degree of kernel breakage among genotypes. One can use a variable rate of feed and variable impeller speed to obtain a desired kernel breakage level. This allows for determination of genetic susceptibility to breakage, breakage associated with rate of drying, and breakage associated with temperature of drying.

Identification of the flavonoid 3'-hydroxylase as an enzyme separate from the 4-hydroxycinnamic acid 3-hydroxylase in sheath and seeds of mature corn plants as well as seedlings - Columbia, Missouri. Characterization of this enzyme as a glycoprotein of low molecular weight makes it unique since this type of protein is not common. Identification of this enzyme in sheaths as opposed to leaves also suggests that groups of these anthocyanin synthesizing enzymes are clustered in different tissues. The lack of oxidase activity in flavonoid 3'-hydroxylase preparations and the presence of oxidase activity in 4-hydroxycinnamic 3 hydroxylase preparations suggests a possible major activity for the latter enzyme in lignin synthesis and a probable minor role in flavonoid biosynthesis.

Enzyme (isozyme) variants significantly associated with yield improvement in corn populations - Raleigh, North Carolina. Laboratory experiments indicate that isozyme variants are significantly associated with yield improvement in corn populations that have been subjected to recurrent selection for improved yield. Recent experiments indicate that grain yield and ear number can be modified by manipulating frequencies of isozyme variants. These results should provide the basis for development of laboratory techniques that will enhance efficiency of selection for improving corn populations.

Maize stripe virus represents a new class of viruses - Wooster, Ohio. The maize stripe virus, (MStpV), found in Florida, causes severe losses in corn. The MStpV particle appears to have a unique structure compared to other plant, animal, or bacterial viruses, with the possible exception of rice stripe virus (RSV). Since such particles may escape detection using standard virological methods, it is possible that some other diseases of plants, animals, or other organisms, where the causative agent is unknown, may be caused by agents of this class.

New inbred line and a breeding population released - Wooster, Ohio. Inbred line Oh1EP and breeding population OhS4(S)C1 were released in 1979. Oh1EP is a germplasm source of resistance to the five known strains of Maize Dwarf Mosaic Virus (MDMV). OhS4(S)C1 combines improved yield with improved resistance to MDMV, MCD, and northern leaf blight and European corn borer leaf feeding.

#### Sorghum:

Water deficits and high temperatures interact to affect plant growth and yield - Lincoln, Nebraska. It was generally found that with mild drought stress maximum dry matter production and grain yield occurred when high temperatures during the vegetative stage were followed by cooler temperatures during flowering and grain filling. Lowest yields occurred when cool temperature growth was followed by high temperatures. With more severe drought stress, highest yields occurred with plants continuously at the cooler temperature. Lowest yields were produced at continuously high temperature. Hot followed by cool or cool followed by hot temperature gave intermediate yields. Genotype differences in response were found. Day and night temperature regimes varied from 30/21C or 35/21C.



Twin-seeded sorghum lines have no yield advantage - Lincoln, Nebraska.  
In Nebraska twin-seeded germplasm has shown no yield nor other advantages over normal-seeded types in a 2-year study, despite claims to the contrary.

Differences identified in sterility responses of three KS male-sterile lines - College Station, Texas. Critical field tests of test-cross progenies established that the male-sterile lines differ slightly in sterility response from the male-steriles now in use. These slight differences indicate their cytoplasms may differ from those of the other steriles. It was confirmed in cooperative mitochondrial studies that the cytoplasms do indeed differ. This is of particular practical importance because these three lines can be used to make the same hybrids as made with the standard steriles. Thus cytoplasmic diversity can be obtained with these lines without shifting to an entirely different spectrum of hybrids -- thus avoiding the increased expense for hybrid sorghum companies and for farmers who buy the seed.

New race of sorghum downy mildew - College Station, Texas. The new race is characterized by its ability to attack previously resistant sorghum varieties. This demonstrates that sorghum downy mildew has the ability to produce virulent races in response to specific types of resistance in the host. Discovery of this potential for variability in the fungus provides an opportunity to develop resistant varieties which will prevent severe damage to sorghum production.

Technological Objective 2: New and improved cultural and management practices that increase corn, sorghum and millet yields, minimize production losses, improve quality attributes, and conserve and use scarce resources efficiently.

#### Research Locations:

Tifton, Georgia  
West Lafayette, Indiana  
Mississippi State, Mississippi  
Brookings, South Dakota

#### Examples of Recent Progress:

##### Sorghum:

Reliable and effective procedures developed for purifying host-specific toxins produced by *Periconia circinata*, and toxins partially characterized - West Lafayette, Indiana. Host-specific toxins are responsible for the pathogenic capacity of numerous fungi. Capability of using purified toxin to study specific effects on the host plant will allow determination of precise mechanisms by which the fungal pathogens damage plants and cause disease.

# INBRED LINES RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
<u>CORN</u>		
GTS1	SEA-Georgia AES	Corn earworm resistance
GTS2	SEA-Georgia AES	Corn earworm resistance
Mp 703	SEA-Mississippi AES	Resistance to southwestern corn borer and fall armyworm
Oh 1EP	SEA-Ohio AES	Resistance to MDMV

# NONCOMMERCIAL GERMPLASM RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
BSAAo <sub>2</sub> (S)C1	SEA-Iowa AES	Protein quality
BS13(S)CI	SEA-Iowa AES	Good population for inbred line extraction
BS16	SEA-Ames AES	Good population for inbred line extraction
B86	SEA-Iowa AES	Resistance to 1st and 2nd broods of European corn borer
Oh S4(S)CI	SEA-Ohio AES	Improved yield, resistance to MDMV, MCD, northern leaf blight and European corn borer.

## P U B L I C A T I O N S

### Gainesville, Florida

Conde, M. R., D. R. Pring, and C. S. Levings, III. 1979. Maternal inheritance of organelle DNA's in Zea mays-Zea perennis reciprocal crosses. J. Hered. 70:2-4.

Levings, C. S., III, and D. R. Pring. 1979. Molecular basis of cytoplasmic male sterility of maize. P. 171-193. In Physiological Genetics, J. C. Scandalios, ed., Acad. Press.

Timothy, D. H., C. S. Levings, III, D. R. Pring, M. F. Conde, and J. L. Kermicle. 1979. Organelle DNA evolution and systematic relationships in the genus Zea: Teosinte. Proc. Natl. Acad. Sci. (USA) 76:4220-4224.

### Urbana, Illinois

Weber, E. J. 1979. The lipids of corn germ and endosperm. J. Amer. Oil Chem. Soc. 56:637-641.

Wilson, C. M. 1979. Studies and critique of Amido Black 10B, Coomassie Blue R, and Fast Green FCF as stains for proteins after polyacrylamide gel electrophoresis. Anal. Biochem. 96:263-278.

### West Lafayette, Indiana

Dunkle, L. D. 1979. Heterogeneous reaction of shattercane to Periconia circinata and its host-specific toxin. Phytopathology 69:260-262.

Odyssey, G. N. and L. D. Dunkle. 1979. Charcoal rot of sorghum: Effect of environment on host-parasite relations. Phytopathology 69:250-254.

### Ames, Iowa

Cortez-Mendoza, H. and A. R. Hallauer. 1979. Divergent mass selection for ear length in maize. Crop Sci. 19:175-178.

Hallauer, A. R. 1978. Potential of exotic germplasm for maize improvement. P. 229-247. In D. B. Walden (ed.) Maize Breeding and Genetics. John Wiley & Sons, New York.

Hallauer, A. R., and O. S. Smith. 1979. Registration of BS13(S<sub>2</sub>) C1 and BS16 maize germplasm (Reg. No. GP81 and GP82). Crop Sci. 19:755.

Loesch, P. J., Jr. 1979. Registration of BSAAO<sub>2</sub>(S)C1 maize germplasm (Reg. No. GP80). Crop Sci. 19:755.

Obiliana, A. T., A. R. Hallauer, and O. S. Smith. 1979. Estimated genetic variability in a maize interpopulation. J. Heredity 70:127-132.

Smith, O. S. 1979. A model for evaluating progress from recurrent selection. Crop Sci. 19:223-226.



Smith, O. S. 1979. Application of a modified diallel analysis to evaluate recurrent selection for grain yield in maize. Crop Sci. 19:819-822.

#### Columbia, Missouri

Blanco, M. H., M. S. Zuber, J. R. Wallin, D. V. Loonan and G. F. Krause. 1979. Host resistance to Stewart's disease in maize. Phytopathology 29: 849-853.

Burleigh, J. R., R. E. McCoy and J. R. Wallin. 1979. Plant pathology models. Pp. 298-334 in Aerobiology, the Ecological Systems Approach, R. L. Edmonds, ed., Nowden, Hutchinson and Ross, Stroudsburg, PA.

Bussard, J. B., and R. L. Larson. 1979. Liquid culture of Diplodia maydis. Microbios 23:147-152.

Coe, E. H., Jr., 1979. Specification of the anthocyanin biosynthetic function by B and R in maize. Maydica 24:49-58.

Doyle, G. G. 1979. The allotetraploidization of maize. I. The physical basis - differential pairing affinity. Theor. Appl. Genet. 54:103-112.

Doyle, G. G. 1979. The allotetraploidization of maize. II. The theoretical basis - the cytogenetics of segmental allotetraploids. Theor. Appl. Genet. 54:161-168.

McCormick, S., 1978. Pigment synthesis in maize aleurone from precursors fed to anthocyanin mutants. Biochem. Genet. 16:777-785.

Wallin, J. R., D. V. Loonan and C. A. C. Gardner. 1979. Comparison of techniques of inoculating corn with Erwinia stewartii. Plant Dis. Repr. 63:390-392.

Wallin, J. R., D. F. Loonan and C. A. C. Gardner, 1979. Erwinia stewartii: An ice nucleus for frost damage to maize seedlings. Plant Dis. Repr. 63:751-752.

#### Lincoln, Nebraska

Clark, R. B., H. J. Gorz, and F. A. Haskins. 1979. Effects of mineral elements on hydrocyanic acid potential in sorghum. Crop Sci. 19:757-761.

Clegg, M. D., C. Y. Sullivan, and J. D. Eastin. 1978. A sensitive technique for the rapid measurement of carbon dioxide concentrations. Plant Physiol. 62:924-926.

Maranville, J. W. and R. B. Clark. 1979. Growth and nutrient uptake in grain sorghum grown under mulch. J. Plant Nutrition 1:255-272.

Martineau, J. R., J. E. Specht, J. H. Williams, and C. Y. Sullivan. 1979. Temperature tolerance in soybeans. I. Evaluation of a technique for assisting cellular membrane thermostability. Crop Sci. 19:75-78.

Ross, W. M., H. J. Gorz, F. A. Haskins, and K. D. Kofoed. 1979. Combining ability in forage sorghum hybrids. Maydica 24:83-89.

Ross, W. M. and K. D. Kofoed. 1979a. Identification of a combine-height grain sorghum dominant for Dw<sub>1</sub>. Crop Sci. 19:123-124.

Ross, W. M. and K. D. Kofoed. 1979b. Effect of non-milo cytoplasms on the agronomic performance of sorghum. Crop Sci. 19:267-270.

Sullivan, C. Y. and W. M. Ross. 1979. Selecting for drought and heat resistance in grain sorghum. P. 263-282. In H. Mussell and R. Staples (ed.). Stress physiology in crop plants. John Wiley & Sons, N.Y.

#### Raleigh, North Carolina

Hadley, B. A., M. K. Eeute, and K. J. Leonard. 1979. Variability in Cylindrocladium crotalariae in response to resistant host plant selection pressure in peanut. Phytopathology 69:1112-1114.

Lillehoj, E. E., D. L. Thompson, and A. J. Bockholt. 1978. Aflatoxin contamination of field corn: Evaluation of regional test plots for early detection. Cereal Chem. 55:1007-1013.

Moll, R. H. and C. W. Stuber. 1979. Registration of two populations of corn germplasm (Reg. No. GP 74 and Reg. No. GP 75). Crop Sci. 19:298-299.

#### Wooster, Ohio

Gingery, R. E., L. R. Nault, and O. E. Bradfute. 1979. Characteristics of a nucleoprotein associated with the maize stripe disease in the United States. IX International Congress of Plant Protection. #219.

Nault, L. R., D. T. Gordon, R. E. Gingery, O. E. Bradfute, and J. Castillo-Loayza. 1979. Identification of maize viruses and mollicutes and their potential vectors in Peru. Phytopathology 69:824-828.

#### College Station, Texas

Craig, J., Edmunds, L. K., Casady, A. J., Webster, O. J., and Sotomayor-Rios, A. 1979. Registration of RSP3BR sudangrass germplasm. Crop Sci. 19:300.

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## National Research Program 20050

### BREEDING AND PRODUCTION--SMALL GRAINS (WHEAT, OATS, BARLEY, RICE, RYE, TRITICALE, WILD RICE, BUCKWHEAT)

Technological Objective 1: New and improved genetic populations, breeding lines, and varieties of small grains that combine greater yield potentials and favored quality characters, including reduced contents of undesirable constituents, with better resistance to pests, tolerance to environmental stress, responsiveness to new cultural and management practices, and adaptation for mechanized culture, harvesting, and handling.

This National Research Program involves research in breeding and production of the cereal small grains to develop new and improved genetic and cultural methods that will result in lower costs to consumers and increased efficiency of production for growers. Research agronomists, geneticists, plant pathologists, plant physiologists, cereal chemists, and other scientists work in a team approach to evaluate and improve small grain varieties and improve cultural methods, or conduct basic research to provide the scientific information necessary to improve techniques of breeding or evaluation.

NPS Contact: L. W. Briggles

#### Research Locations:

Palmer, Alaska	Bozeman, Montana
Tucson, Arizona	Lincoln, Nebraska
Stuttgart, Arkansas	Fargo, North Dakota
Davis, California	Wooster, Ohio
Aberdeen, Idaho	Stillwater, Oklahoma
Urbana, Illinois	Corvallis, Oregon
Ames, Iowa	University Park, Pennsylvania
Manhattan, Kansas	Mayaguez, Puerto Rico
Crowley, Louisiana	Brookings, South Dakota
Beltsville, Maryland	Beaumont, Texas
East Lansing, Michigan	Logan, Utah
St. Paul, Minnesota	Pullman, Washington
Columbia, Missouri	Madison, Wisconsin

#### Examples of Recent Progress:

##### Small Grains in General:

Seed increase - Aberdeen, Idaho. Over 17,000 single or multi-row plots and over 5,000 spaced plants of oats, barley, and wheat were grown for 19 SEA/AR, Agricultural Experiment Station, and industry projects located in 12 States

in 1979. Included were portions of the World Small Grains Collection, future entries for the International Rust Nurseries, and the SEA/AR-University of Minnesota *Avena fatua* collection.

Seed Increase - Obregon, Mexico. Over 15,800 selections, genetic lines, and separate seed lots of durum, hard red spring wheat, and barley were grown in the winter increase program conducted cooperatively by SEA/AR, the Crop Quality Council (Minneapolis, Minnesota), and the North Dakota, South Dakota, and Minnesota Agricultural Experiment Stations. This service is provided to small grains research personnel in the spring grain area. Use of the winter nursery allows advance of an extra generation per year toward homozygosity, additional selection for favorable characters and disease resistance, plus seed increase for yield and quality tests.

Variety and germplasm releases - U.S. One wheat, two barley, and four rice varieties were released cooperatively by SEA/AR and the State Agricultural Experiment Stations in 1979. Twenty-two wheat and 14 barley germplasm populations were released by the same agencies in 1979.

Special nurseries - Beltsville, Maryland. Three international and four uniform wheat and oat nurseries, consisting of 970 entries, were prepared and distributed to 143 locations in 44 countries for determining reactions to different biotypes of disease producing organisms. In addition, two more wheat international nurseries were distributed from Lincoln, Nebraska, and approximately 20 uniform nurseries involving wheat, oats, barley, and rice were distributed within the U.S. from project locations other than Beltsville. Most of the latter are performance nurseries where advanced breeding lines are tested for characters such as yield, disease resistance, and lodging resistance.

Wheat:

Wheat and oat striate mosaic viruses are different - Urbana, Illinois.

Wheat striate mosaic virus was transmitted by several populations of *Endria inimica* (painted leafhopper) collected in Illinois and North Dakota, but oat striate mosaic virus, readily transmitted by *Graminella nigrifrons*, (black-faced leafhopper) was not transmitted by *E. inimica*.

Quality testing of Hard Red Winter Wheat breeding lines - Manhattan, Kansas. About 570 early generation samples (40 to 100 g) were evaluated for milling quality and for baking quality by very preliminary test procedures. About 580 samples (1,500 g each) of agronomically promising advanced breeding lines and recently released varieties were evaluated for milling and baking quality. Certainly leading commercial wheat varieties of tomorrow are among them. Within the latter groups, 45 had from 1.0 to 3.8 percentage points more grain protein than the controls.

Decline in grain protein of Hard Red Winter Wheat reversed - Manhattan, Kansas. During the 5 years 1975-79, the average wheat yield in Kansas (31.1 bu/A) was 6.9 bushels greater and average grain protein (11.9%) was 0.2 higher than the corresponding averages for the 1960's. The gradual decline in grain protein apparently has been halted and reversed during the past 5 years by release of such higher protein varieties as Eagle, Sage, and Lancota. Without new varieties of the 1970's, Kansas wheat protein probably would have continued to decrease to about 11%.



Amino acid composition of wheat grain and wheat grain dust - Manhattan, Kansas. Protein was about one to two percentage points less in dust than in the grain. The essential amino acids lysine and threonine were higher in the protein of wheat dust than in grain; glutamic acid and proline were higher in wheat grain protein than in wheat dust proteins.

No major shifts in virulence frequencies of wheat leaf rust - Manhattan, Kansas. A major survey of pathogenicity in the U.S. in 1979 revealed a trend toward increased virulence frequency to genotypes with *Lr1*, *Lr2a*, and *Lr9*, but no major changes.

New sources of resistance to wheat mildew - Beltsville, Maryland. Approximately 1,600 introductions and breeding lines were evaluated for reaction to virulent cultures of *Erysiphe graminis tritici*. Seedlings of 50 wheats were inoculated individually with six cultures. Differences in rate of disease development were apparent between varieties. A number of possible new sources of resistance was determined, and an elite set of 114 lines resistant to powdery mildew was established and distributed.

Wheat anther culture - Beltsville, Maryland. Anther culture has proven to be of higher frequency in certain genotypes. Both field and greenhouse grown plants can be used as donors. A study is underway to determine the genetics of those that culture more readily versus those that culture at low frequency or not at all. Factors conditioning good "anther culturability" can be transferred to  $F_1$  plants. Successful anther culture can be used to obtain doubled haploid lines which may represent a useful breeding method by shortening the time needed to develop new wheat varieties.

Improved method for transfer of alien genetic material to wheat - Columbia, Missouri. An improved method for the use of induced homoeologous chromosome pairing to effect transfer of alien genetic material provides for the transfer of a short segment of alien chromosome carrying a desired gene, no matter where that gene is located on the alien chromosome. This procedure reduces the chance for undesirable genes to be transferred along with the desirable ones.

Recurrent selection procedure is effective for increasing wheat grain protein-- Bozeman, Montana. High protein lines from a recurrent selection program were selected in the second cycle on the basis of protein yield (g/ft. of row). Selection up to the second cycle had been based on grain protein percent only. A higher percent of high yield, high protein lines were obtained using the latter procedure.

High protein and high yield in wheat are compatible - Lincoln, Nebraska. Evidence of compatibility of high protein and high grain yield was obtained in field experiments. Lancota and the experimental line NE 7060 both were higher in yield and in grain protein than other varieties with which they were compared in replicated trials. Artificial defoliation at heading significantly reduced both yield and protein indicating the importance of foliage retention for high yield and high protein. Application of 120 pounds nitrogen increased grain protein in all varieties approximately two percentage points.

International Winter Wheat Performance Nursery (IWWPN) provides important research information - Lincoln, Nebraska. The 11th IWWPN grown in 1979 contained 30 entries and was grown at 68 locations in 38 countries. Since the nursery was organized in 1969, 136 new winter wheat varieties from 25 countries have been evaluated worldwide. High protein and high lysine breeding lines from the SEA/AR-University of Nebraska program are also sent to the IWWPN locations. Performance data and grain samples for quality analysis are returned to Lincoln, Nebraska. Data from replicated tests at Yuma, Arizona, reflect excellent progress in combining high protein and high lysine with high grain yield.

Quality testing of hard red spring wheat and durum breeding lines - Fargo, North Dakota. Quality evaluation tests were conducted on 1,298 hard red spring wheat samples which were received from 21 locations in eight states. A total of 704 durum samples were analyzed. They were received from 15 locations in eight states. An additional 17 large-scale Crop Quality Council HRS lots were processed for evaluation by the Laboratory and by industry participating collaborators.

Fiber breads provided for human feeding trials - Fargo, North Dakota. A total of 2,477 one-pound loaves of frozen bread dough was prepared for the Human Nutrition Laboratory at Grand Forks, North Dakota. Of these, 1,040 loaves were made from spring wheat flour only; 310 contained spring wheat flour and corn bran; 392 included spring wheat flour and soybean hulls; 315 were from spring wheat flour and apple fiber; 90 contained spring wheat flour and durum bran; 80 included spring wheat flour and wheat germ; 50 had spring wheat flour and Eagle bran (soft wheat bran); 200 contained spring wheat flour and three types of spring wheat bran.

Inheritance of greenbug resistance transferred to hexaploid wheat from wild grass - Fargo, North Dakota. Resistance to a toxin produced by the greenbug was transferred to wheat by crossing Langdon durum with *Triticum tauschii* (*Aegilops squarrosa*), and the chromosome number doubled to produce a resistant amphiploid. Resistance is controlled by a single dominant gene which should be easily transferable to new wheat varieties. Control through use of this resistance is inexpensive and nonpolluting.

New breeding method increases durum yields - Fargo, North Dakota. A new breeding method involves combining diverse germplasm, bulk testing, followed by recurrent selection. In the first cycle of selection, a new line was developed with a yield superior to all currently grown U.S. durum varieties.

Chromosome location of strong gluten in durum identified - Fargo, North Dakota. Recent reports from laboratories in Canada, France, and the USSR identified a protein band in durum gliadin which is associated with strong gluten. Further electrophoresis studies conducted in cooperation with the Northern Regional Research Laboratory (Peoria, Illinois) indicate that this gliadin band is controlled by chromosome 1B of durum. Strong gluten durum is desired by U.S. pasta manufacturers and by overseas markets. The new method for identifying this character in early generations (individual F<sub>2</sub> seeds) increases breeding efficiency and hastens the day when all U.S. durums will have strong gluten.



Slow rusting wheat germplasm found - Fargo, North Dakota. Lines were identified that show a slow rate of stem rust infection even though they develop susceptible type lesions. These lines have minimal reduction in grain yield and quality due to rust infection. This trait can serve as valuable back-up protection for currently used specific genes for resistance.

New wheat stem rust test cultures developed - Fargo, North Dakota. Genetic experiments with the stem rust pathogen led to selection of new rust cultures that can be used to identify all known genes for resistance in wheat host plants. These cultures will facilitate breeding and selection of new high yielding wheat varieties resistant to stem rust.

Quality testing of Eastern Soft Red Winter and Soft White Winter Wheat - Wooster, Ohio. Milling and baking quality of 4,364 samples was determined. Of these, 2,693 were early generation breeding material. There was a significant increase in number of samples submitted by breeders in 1979.

Soft wheat milling evaluation improved - Wooster, Ohio. Kernel texture is now related to bread flour yield. This association, along with increasing the precision of a small scale milling test so that flour yield correlates better with a rigorous large scale milling test, greatly facilitate evaluation of milling quality. This allows the breeder to more effectively select early in the breeding procedure for milling quality.

Chlorinated flour lipids aid cake improvement - Wooster, Ohio. Much of the cake volume increase due to flour chlorination can be attributed to the treatment effect on lipids, but the effect is nonspecific. Cake volume differences in flour are maintained when the lipids are interchanged. The flour factor responsible for differential cake potential is in the nonlipid portion of flour.

Resistance to Hessian fly is being transferred from rye to wheat - Stillwater, Oklahoma. Several hundred resistant plants were obtained from crosses of Seuwon 92 wheat with Balbo or Gator rye. They are being propagated for further crossing. In addition, several hundred amphiploid plants from Chinese Spring wheat X Balbo and Gator rye were produced. It is possible that resistance to wheat streak mosaic will likewise be transferred.

Greenbug resistant wheat germplasm distributed - Stillwater, Oklahoma. Seed of greenbug resistant Amigo has been sent to over 50 plant breeders in the U.S. and 11 foreign countries. Several lines developed from crosses of Amigo with commercial wheats are being increased. Data thus far obtained indicate these lines have acceptable quality and good yield potential, as well as resistance to greenbug.

Winter hardy triticale lines identified - Corvallis, Oregon. Triticale lines sufficiently winterhardy for the Pacific Northwest are now available. They have been tested also at Lincoln, Nebraska, and Lacombe, Alberta, Canada. Some triticales continue to show good resistance to leaf and stripe resistance, common bunt, and powdery mildew.



Valuable wheat germplasm collected in Turkey - Corvallis, Oregon and Logan, Utah. SEA/AR and Turkish scientists conducted an extensive collection of wheat in eastern and southeastern Turkey. This area is a primary center of diversity for wheat and its wild relatives. Consequently, it is also a primary source of resistance to several destructive cereal pathogens, particularly wheat smuts.

Quality testing of Western wheats - Pullman, Washington. Milling and baking evaluations were determined for 1,025 preliminary and advanced breeding lines. An additional 2,904 early generation samples were evaluated for milling and baking quality by small scale tests. Still another 329 single plant samples were screened for milling quality and grain protein by micro tests. Protein and lysine were determined on 1,086 hard red winter lines involving high protein and/or lysine sources. Grain protein ranged from 9.6 to 17.0%. More than 4,000 samples representing current varieties, parent lines, and progenies were analyzed for alpha-amylase activity by the Nephelometric method.

New variety establishes new yield plateau for club wheats - Pullman, Washington. Tyee, a new semidwarf club wheat, is the highest yielding club wheat in the Pacific Northwest. It is resistant to predominant races of stripe rust and common bunt, and has excellent milling and baking quality.

Recently released soft white winter wheat reduces vulnerability of wheat crop to low temperature - Pullman, Washington. Unusual cold weather during the winter of 1978-79 killed 28% of the fall-sown wheat in Washington. Daws survived when most other varieties were severely damaged. Superior winterhardiness, high yield, and stable stripe rust resistance prompted Pacific Northwest farmers to seed over 1,000,000 acres of Daws in the fall of 1979.

Oats:

Increased groat percent in oats - Aberdeen, Idaho. A new selection is of interest as germplasm for improved groat percent. It averaged 77.0% groats versus 71% for Cayuse, 70% for Corbit, and 74% for Otana in three Idaho trials, yet equaled Cayuse in yield. It is slightly lower in test weight than Cayuse.

*Rhopalosiphum padi* aphids responsible for rapid spread of Yellow Dwarf Virus - Urbana, Illinois. *R. padi* (apple grain) aphids can transmit the virus to oats about twice as fast as *Macrosiphum granarium* (English grain) aphids. Presence of the former in fields is more of a threat and should be a warning to farmers to plant Yellow Dwarf Virus resistant varieties or to spray for aphid control to minimize losses.

Effect of crown rust infection on oat grain protein - Ames, Iowa. Oat varieties showed significant differences in response of protein concentration of grain to rust infection. Significant reduction occurred in one line and significant increase in five others. Effects of crown rust on protein were not correlated with inherent yielding ability or grain protein of the same varieties in adjacent rust-free control plots.

Cell, tissue, and anther culture as tools for germplasm development in oats - St. Paul, Minnesota. Seven of 32 lines of the wild oat *Avena fatua* produced regenerable tissue cultures at a frequency of 45 to 88%. Such frequencies are comparable to those of the best responding lines of commercial oats. Only three of 16 *A. sterilis* lines produced regenerable cultures and these were at a frequency of 3 to 12%. Callus was produced from 654 among 14,000 anthers of Stout and Clintford oat varieties planted. Several anther-derived calluses were prolific in growth, but no plants were produced.

Improvement of technology to select for resistance to freeze stress - University Park, Pennsylvania. A major barrier to improvement of winter hardiness in cereal crops has been limited success in selecting for the trait with accuracy. The individual crown freezing technique promises to provide the breeder with a useful tool to select for resistance to freeze stress, a major component of winter hardiness in the field. In an oat population synthesized from varieties representing a range in hardiness, one cycle of controlled freeze stress, followed by selection of surviving plant crowns, brought the population to 95% of the most hardy component variety. This test should be very useful to eliminate much of the costly, inaccurate testing that has been necessary under field conditions.

Quality testing of oats - Madison, Wisconsin. In 1979, 30,520 oat samples (primarily oat groats) were analyzed for protein at the National Oat Quality Laboratory. The Udy dye-binding procedure was replaced by infrared reflectance analysis. Samples analyzed were primarily breeders samples from State and Federal oat breeding programs.

Genetic variability in oat storage protein composition - Madison, Wisconsin. Among *Avena sativa* (common oats) varieties, globulin fractions were mostly similar by SDS polyacrylamide gel electrophoresis. Minor differences in bands revealed by electrofocusing may be useful for varietal identification.

#### Barley:

Improved germplasm developed - Beltsville, Maryland. Four barley composite crosses with excellent leaf rust, powdery mildew, and scald resistance were released and distributed to plant breeders throughout the world.

New germplasm to help prevent barley disease losses - Beltsville, Maryland. Resistance to the pathogens causing leaf rust and powdery mildew was found in *Hordeum spontaneum*. The leaf rust resistance was conditioned by one to three genes and resistance to powdery mildew by two to four genes. The genes can readily be incorporated into a breeding program. Individual accessions of this wild species are often resistant to many diseases and can contain several resistance genes for each disease. Resistance in *H. spontaneum* should be very useful.

Characterization of injury caused by freezing stresses to identify protective systems in winter cereals - East Lansing, Michigan. Hardened vegetative winter cereal plants are killed by freeze desiccation near -20 C although embryos in seed can survive extreme dehydration. Embryos removed from seed are much more vulnerable. Extreme resistance to desiccation of embryos from germinating seed was related to delayed development of certain cells, not a property of dividing



cells. Studying development of those cells resistant to desiccation injury at the time seeds are formed may provide clues to mechanisms of hardiness involved with freeze desiccation.

Isolation of diffusible substances that contribute to winter hardiness may lead to identification of heritable traits associated with hardiness - East Lansing, Michigan. Use of a unique apparatus allows for flushing cell wall regions of cereal plant crowns with water, solutions, or other solvents, or gas pressure can be applied for psychrometry. Forced guttation with water at 30 lbs./in.<sup>2</sup> flushes the outer free space of barley crowns in 30 minutes without injury. Both inhibitors of freezing kinetics and adhesion inhibitors are extracted by this method. It can be applied to field plants and may be the simplest means of obtaining diffusible cryoprotectants for classification of genotypes for hardiness.

Two new barley varieties released - Bozeman, Montana. Ershabet, an early maturing two-row feed barley, is recommended for production in areas with a short growing season, where moisture is limiting, or if planting is delayed. Ridawn, also a two-row feed barley, is recommended for use as hay (awns are shed).

Maintenance of male sterility and restoration of male fertility are independent of environment - Bozeman, Montana. Preliminary results indicate stability of male sterility and fertility restoration. Agronomic characteristics of the fertile hybrid plants are not significantly altered. This information indicates that cytoplasmic male sterility could be used to produce hybrid barley.

New source of resistance to Yellow Dwarf Virus - Fargo, North Dakota. A new source of resistance to Yellow Dwarf Virus (YDV) was transferred from a wild grass species (*Elymus mollis*) to barley. Genes from the grass that condition YDV reaction are different from those present in resistant barleys now grown. The new source of resistance should make it possible to develop barley varieties more resistant to YDV than those now available. Tests are underway to determine the relationship of the *E. mollis* factor(s) to the Yd<sub>2</sub> gene which imparts resistance to some commercial barleys.

Progress toward high oil content in barley - Brookings, South Dakota. Five of 17,318 accessions in the World Barley Collection selected for high oil were crossed with commercial varieties Morex and Primus II. Single crosses, backcrosses, and diallel crosses will be tested for oil content by NMR analysis when advanced to F<sub>3</sub>.

Quality testing of malting barley - Madison, Wisconsin. A total of 3,421 barley samples from breeders has been malted and analyzed for various quality characteristics.

New method for assaying  $\beta$ -D - glucans in cereal grain - Madison, Wisconsin. The new method differs from existing procedures in that: (a) it utilizes a higher extraction temperature (80 C) to extract the more highly polymerized forms of  $\beta$ -glucans, which existing methods appear to miss, and (b) it is more specific for glucosidic bonds of the  $\beta$ -configuration because it utilizes a



purified fungal enzyme that does not hydrolyze  $\alpha$ -linkages such as starch. The method should have wide application in assaying cereals for  $\beta$ -glucans which cause problems in both feed use and in brewing.

Rice:

Increased seed set on cytoplasmic male-sterile rice - Davis, California. About 30% hybrid seed set was obtained on more than 400 cytoplasmic male sterile plants. This is a marked improvement over previous 1 to 5% seed set. Part of the increase is attributed to using short female plants with tall pollinators. The advance in amount of seed set, plus discovery of a dominant dwarfing gene, provide impetus for new investigations toward development of hybrid rice.

Three new rice varieties released - Davis, California. M 101 (medium grain), L 201 (long grain), and Calmochi 201 (short grain with non-glutinous endosperm), were released by SEA/AR, the University of California, and the California Cooperative Rice Research Foundation.

Selection for salt tolerance in rice - Davis, California. To date, 13 rice cell lines have been isolated which exhibit capacity to grow on medium containing salt levels typically fatal to rice cells. The most tolerant line originated from an explant of a haploid SD7 plant, and is growing well on medium containing 1.5% NaCl.

Testing for nutritional quality - Beltsville, Maryland. Approximately 3,450 rice samples from accessions in the World Rice Collection were analyzed for grain protein and lysine.

New rice variety released - Beaumont, Texas. Newrex (long grain) was released to fill specific industry needs. It has uniquely superior qualities for par-boil, quick-cook, soup canning, and is superior for nonprocessed table use.

Quality testing of rice - Beaumont, Texas. About 9,000 breeding lines were evaluated for amylose percent, alkali spreading, paste viscosity, and grain protein. In addition, 1,300 new introductions in the World Rice Collection were classified for hull color, grain size and shape, bran color, endosperm type, amylose percent, alkali spreading, canning stability and grain protein.

Technological Objective 2: New and improved cultural and management practices that increase small grain yields through disease, insect, and weed control; that minimize environmental stress; that improve physical and nutritional quality attributes; that minimize production losses; and that conserve and more efficiently use scarce or irreplaceable resources.

## Research Locations:

Palmer, Alaska  
Gainesville, Florida  
Aberdeen, Idaho  
Urbana, Illinois  
Manhattan, Kansas  
Lincoln, Nebraska  
Corvallis, Oregon

University Park, Pennsylvania  
Brookings, South Dakota  
Beaumont, Texas  
Logan, Utah  
Pullman, Washington  
Madison, Wisconsin

## Examples of Recent Progress:

### Wheat:

Progress made in selecting for nonspecific resistance to leaf rust - Gainesville, Florida. Use of nonspecific resistance (NSR) will reduce genetic vulnerability of wheat to disease; but NSR cannot be used in its present form. Improvement can be made by selecting and combining major components of NSR. Wheat lines with low receptivity (low infection rate), small pustules, and extended latent periods were selected (each in separate lines), and intercrosses have been made to combine the components.

Management practices to control *Septoria* head blight of wheat - Gainesville, Florida. Management practices that reduce the load of inoculum and rate of disease progress, such as clean seed, treated seed, noninfested soil, etc., are required. Head infection > 15% drastically lowered kernel weight. Head infection > 10% significantly increased percent seed infection. Heads infected early had 10% more infected seed than heads infected 10 days later.

Reaction of corn to certain viruses is dependent upon temperature - Lincoln, Nebraska. A series of experiments showed that corn is susceptible to barley stripe mosaic virus at 25 C, but not at 35 C. Conversely, corn is more susceptible to wheat streak mosaic virus at 35 C than at 25 C. Corn showing the aberrant ratio phenomenon (unexpected segregation ratio for resistance versus susceptibility in virus infected plants) was not resistant to the viruses that induced the phenomenon. A nursery of 38 corn lines was screened for reaction to wheat streak mosaic virus--16 lines were susceptible.

Soilborne mosaic virus identified in spores of the *Polymyxa graminis* vector - Lincoln, Nebraska. Cystosori of *Polymyxa graminis* have been isolated enzymatically by digestion of infected wheat roots with commercial cellulase and pectinase enzymes. Cystosori were washed by centrifugation, taken up in a small amount of water, and placed on CsCl 50%-0% gradients in 60% sucrose. Resting spores and some cell debris of the same density were recovered from the 40-50% CsCl region.

Problem of TCK (dwarf smut) in wheat shipments to the People's Republic of China (PRC) - Corvallis, Oregon. The PRC stopped buying white wheat from the Pacific Northwest in 1974 following the appearance of smut spores in wheat shipments. Because of diligent efforts on the part of Dr. E. J. Trione, in a series of detailed scientific discussions and communications with representatives of the PRC, the Chinese resumed buying wheat in late 1979 and early

1980. Value of those wheat contracts exceeded \$200 million. Their grain testing laboratories are using new tests developed at Corvallis for identification of TCK spores.

Reduced efficacy of thiabendazole to control dwarf smut with commercial seed treatment compared to laboratory seed treatment - Logan, Utah. Initial studies in growers' fields and experimental nurseries indicate seed treatment with thiabendazole at efficacious rates can significantly reduce seedling emergence, final stand, and yield of some varieties.

Wheats for conservation tillage - Pullman, Washington. Three years of tests indicate breeders have latitude in developing varieties adapted to conservation tillage systems. A range of types differing in height, head type, and awn expression have potential. Wheats that achieve adequate stands and those that are not seriously delayed in heading are adapted to conservation tillage.

Take-all decline is model system for fundamental studies on disease decline mechanisms - Pullman, Washington. After 10 years research, there is conclusive evidence that take-all (*Gaeumannomyces graminis*, a soilborne disease) declines in severity with wheat monoculture. Rotation with crops such as alfalfa, potatoes, or oats will interrupt this natural biological control. This fact has far-reaching implications because crop rotation has long been used for one kind of control of soilborne pathogens. Although take-all decline may occur in three-five years, other disease decline phenomena conceivably could require 50-100 years.

Bacteria zap wheat root disease - Pullman, Washington. The significant reduction in take-all in field plots by use of antibiotic bacteria applied on seed is the first instance in the U.S. of control of a wheat root disease with bacterization of wheat seed. Even better control should be possible with improved strains of bacteria. The day is near when bacteria on seeds will give biological control much as a fungicide on seed gives chemical control.

Resistance to stripe rust - Pullman, Washington. A screening method to identify race specific and nonspecific resistance to stripe rust is now used to evaluate germplasm and all new wheat lines developed in the Pacific Northwest. Many of these lines have the high temperature, adult plant resistance that has not been vulnerable to new races.

Oats:

Basic nature of nonspecific resistance to cereal rusts - Gainesville, Florida. Low receptivity (LR) is a major component of nonspecific resistance (NSR) of oats to crown rust. LR is characterized by fewer pustules/cm<sup>2</sup> on varieties that have NSR. Spore germination, appressoria formation, and appressoria penetration were not correlated with LR, indicating that mechanisms controlling LR occur after host penetration. LR was conditioned by an infection threshold of about 20% disease severity.



# VARIETIES RELEASED

<u>Name or Designation</u>	<u>Class or Type</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
<u>WHEAT</u>			
Tyee	White, club winter wheat	SEA-Washington AES Oregon AES, Idaho AES	Resistant to several races of the stripe rust; has very good club wheat milling and baking quality traits.
<u>RICE</u>			
M-101	Medium grain	SEA-California AES and California Cooperative Rice Foundation, Inc.	Earlier in maturity than any other medium grain cultivar being grown in California. Yielded well in all parts of the rice growing area. Because of its earliness, short stature and cold tolerance in the seedling and reproduction stages, it is particularly suited for the cooler areas of the State and for late seedings.
Calmochi-201	Short grain with waxy endosperm	SEA-California Cooperative Research Foundation, Inc., California AES	Has nonglutinous endosperm and is a popular cultivar in California.
L-201	Long grain cultivar	SEA-California AES, California Cooperative Rice Research Foundation, Inc.	First long grain cultivar to be re- leased for commercial production in California, early maturity, good straw strength.
Newrex	Long grain	SEA-Texas A&M University AES	Superior to other U.S. long grain varieties for quick-cook processing, superior lodging resistance.

<u>Name or Designation</u>	<u>Class or Type</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
<u>BARLEY</u>			
Ershabet	Two-row spring feed barley	SEA-Montana AES	Recommended for production in stress areas where the growing season is short, where moisture is limiting, or planting is delayed.
Ridawn	Two-row spring hay barley	SEA-Montana AES	Recommended for use as hay (awns are shed).
NONCOMMERCIAL GERMPLASM RELEASED			
<u>Name or Designation</u>		<u>Release Agencies</u>	<u>Reason for Release</u>
<u>WHEAT</u>			
6 elite highly resistant lines to cereal leaf beetle		SEA-Michigan AES	Resistant HRS wheat germplasm for use in breeding programs.
16 winter wheat isolines of different culm lengths		SEA-Washington State University, College of Agriculture Res. Center	In addition to influencing culm length, some of the genotypes have been shown to influence other traits such as grain yield, harvest index, seed weight, test weight, lodging, shattering, postharvest dormancy, crown depth, coleoptile length, seedling vigor and disease incidence.
<u>BARLEY</u>			
10 elite resistant barleys		SEA-Michigan AES	Six row spring barley germplasm. Cereal leaf beetle resistant spring barley.
Composite Cross XXXV, XXXV-A to C		SEA-Beltsville, MD	Spring barley germplasm, resistant to leaf rust, powdery mildew, and scald.

## P U B L I C A T I O N S

### Palmer, Alaska

Brundage, A. L., R. L. Taylor, and V. L. Burton. 1979. Relative yields and nutritive values of barley, oats, and peas harvested at four successive dates for forage. J. of Dairy Science 62:740-745.

### Stuttgart, Arkansas

Johnston, T. H., B. R. Wells, M. A. Marchetti, and S. E. Henry. 1979. Registration of Nova 76 rice (Reg. No. 48). Crop Sci. 19:743.

Johnston, T. H., B. R. Wells, M. A. Marchetti, F. N. Lee, and S. E. Henry. 1979. Registration of Mars rice (Reg. No. 49). Crop Sci. 19:743-744.

### Davis, California

Rutger, J. N., K. W. Foster, K. S. McKenzie, D. J. Mackill, M. L. Peterson, and C. H. Hu. 1979. Registration of six germplasm lines of rice. Crop Sci. 19:299-300.

Mackill, D. J. and J. N. Rutger. 1979. Inheritance of induced-mutant semi-dwarfing genes in rice. J. Hered. 70:335-341.

Rutger, J. N., M. L. Peterson, H. L. Carnahan, and D. M. Brandon. 1979. Registration of M-101 rice. Crop Sci. 19:929.

### Gainesville, Florida

Luke, H. H. and R. D. Barnett. 1979. The influence of harvest conditions on the germinability and mycoflora of rye seed. Seed Science and Technol. 7:431-437.

Berger, R. D. and H. H. Luke. 1979. Spatial and temporal spread of oat crown rust. Phytopath. 69:1199-1201.

### Ames, Iowa

Simons, M. D., P. G. Rothman, and L. J. Michel. 1979. Pathogenicity of Puccinia coronata from buckthorn and from oats adjacent to and distant from buckthorn. Phytopath. 69:156-158.

Simons, M. D. 1979. Modification of host-parasite interactions through artificial mutagenesis. Ann. Rev. Phytopathol. 17:75-96.

Simons, M. D., V. L. Youngs, G. D. Booth, and R. A. Forsberg. 1979. Effect of crown rust on protein and groat percentages of oat grain. Crop Sci. 19:703-706.



#### Manhattan, Kansas

Finney, K. F. 1979. Wheat proteins: What they do. USDA Agricultural Research Manual ARM-9: 50-61.

Hubbard, J. D., L. M. Seitz, and H. E. Mohr. 1979. Determination of hexosamines in chitin by ion-exchange chromatography. J. of Food Science 44:1552-1553.

Lookhart, G. L. 1979. Note on an improved method of extracting and quantitating coumestrol from soybeans. Cereal Chem. 56(4): 386-388.

Shogren, M. D., Y. Pomeranz, and K. F. Finney. 1979. Low-lactose bread. Cereal Chem. 56(5):465-468.

#### Crowley, Louisiana

McIlrath, W. O., N. E. Jodon, E. A. Sonnier, G. J. Trahan, and M. A. Marchetti. 1979. Registration of LA 110 rice. Crop Sci. 19(5):744-745.

#### Beltsville, Maryland

Baenziger, P. S., R. A. Kilpatrick, and J. G. Moseman. 1979. Reduced root and shoot growth caused by Erysiphe graminis tritici in related wheats grown in nutrient solution culture. Can. J. Bot., 57:1345-1348.

Golan, Tamar, Y. Anikster, J. G. Moseman, and I. Wahl. 1978. A new virulent strain of Puccinia hordei. Euphytica 27:185-189.

Johnson, J. W., P. S. Baenziger, W. T. Yamazaki, and R. T. Smith. 1979. Effects of powdery mildew on yield and quality of isogenic lines of Chancellor wheat. Crop Sci. 19:349-352.

Moseman, J. G. and P. S. Baenziger. 1979. Registration of barley composite crosses XXXV, XXXV-A, -B, and -C (Reg. Nos. GP27 to GP30). Crop Sci. 19(5): 750-751.

Schaeffer, G. W., P. S. Baenziger, and J. Worley. 1979. Haploid plant development from anthers and in vitro embryo culture of wheat. Crop Sci. 19:697-702.

#### St. Paul, Minnesota

Busch, R. H. and D. Luizzi. 1979. Effects of intergenotypic competition on plant height, days to heading and grain yield of F<sub>2</sub> through F<sub>5</sub> bulks of spring wheat. Crop Sci. 19:815-819.

Martin, C. D., J. D. Miller, R. H. Busch, and L. J. Littlefield. 1979. Quantitation of slow rusting in seedling and adult spring wheat. Can. J. of Bot. 57:1550-1556.

Rines, H. W., D. D. Stuthman, L. W. Briggles, V. L. Youngs, H. Jedlinski, D. H. Smith, J. A. Webster, and P. G. Rothman. 1980. Collection and evaluation of Avena fatua for use in oat improvement. Crop Sci. 20:63-68.

### Columbia, Missouri

Sears, E. R. and L. M. S. Sears. 1978. The telocentric chromosomes of common wheat. Proc. 5th Int. Wheat Genet. Symp. (New Delhi), Vol. 1:389-407.

### Bozeman, Montana

Carroll, T. W., P. L. Gossel, and E. A. Hockett. 1979. Inheritance of resistance to seed transmission of barley stripe mosaic virus in barley. Phytopath. 69:431-433.

Gilbertson, K. M. and E. A. Hockett. 1979. The effect of hail damage on barley. Can. J. Pl. Sci. 59:1147-1152.

Hockett, E. A. and H. Ahokas. 1979. Male and female fertility levels of genetic male sterile barley grown at two different latitudes. Hereditas 91:65-71.

Kazemi, H., S. R. Chapman, and F. H. McNeal. 1978. Variation in stomatal number in spring wheat cultivars. Cereal Research Communications. 6(4):359-365.

McGuire, C. F., E. A. Hockett, and D. M. Wesenberg. 1979. Response of agronomic and barley quality traits to nitrogen fertilizer. Can. J. Pl. Sci. 59:831-837.

McNeal, F. H. and M. A. Berg. 1979. Stem solidness and its relationship to grain yield in 17 spring wheat crosses. Euphytica 28:89-91.

### Lincoln, Nebraska

Schmidt, J. W., V. A. Johnson, P. J. Mattern, A. F. Dreier, and D. V. McVey. 1979. Registration of Agate wheat. Crop Sci. 19:748.

Schmidt, J. W., V. A. Johnson, P. J. Mattern, A. F. Dreier, and D. V. McVey. 1979. Registration of Lancota wheat. Crop Sci. 19:749.

Finkner, R. E., J. W. Schmidt, and V. A. Johnson. 1979. Registration of Capitan wheat. Crop Sci. 19:748.

Morris, R., P. J. Mattern, J. W. Schmidt, and V. A. Johnson. 1979. Studies on protein, lysine, and leaf rust reactions in the wheat cultivar Atlas 66 using chromosome substitutions. p. 447-454. In Proc. Fifth Int. Wheat Genetics Symp., New Delhi, India.

Johnson, V. A. and P. J. Mattern. 1978. Improvement of wheat protein quality and quantity by breeding. Adv. in Exp. Med. and Biol. 105:301-316.

Kuhr, S. L., K. D. Wilhelmi, V. A. Johnson, P. J. Mattern, and J. W. Schmidt. 1979. Results of the Ninth International Winter Wheat Performance Nursery Grown in 1977. Nebr. Res. Bul. 288. 246 pp.

Brakke, M. K. 1979. Ultraviolet absorption spectra and difference spectra of barley stripe mosaic and tobacco mosaic viruses in buffer and sodium dodecyl sulfate. *Virology* 98:76-87.

Samson, R. G., M. K. Brakke, and W. A. Compton. 1979. Evidence for gene inactivation in the virus-induced aberrant ratio phenomenon in maize. *Genetics* 92:1231-1239.

Langenberg, W. G. 1979. Ribonucleic acid fixation by glutaraldehyde -- implications for the interpretation of electron micrographs. *Phytopath.* 69:1035.

#### Fargo, North Dakota

Dick, J. W., W. C. Shuey, and O. J. Banasik. 1979. Bread-making quality of air-classified hard red spring wheat manipulated flour blends. *Cereal Chem.* 56(5):480-485.

Fernandes, J. L. A., W. C. Shuey, and R. D. Maneval. 1979. Bread wheat granular mill streams with potential for pasta production. II. Effect of crop year, wheat classes, and eggs on processing spaghetti. *Cereal Chem.* 56(6):520-524.

Mousa, E. I., R. H. Ibrahim, W. C. Shuey, and R. D. Maneval. 1979. Influence of wheat classes, flour extractions, and baking methods on Egyptian Balady bread. *Cereal Chem.* 56(6):563-566.

Youngs, V. L. and R. A. Forsberg. 1979. Protein-oil relationship in oats. *Crop Sci.* 19:798-802.

Joppa, L. R., J. A. Bietz, and N. D. Williams. 1978. The aneuploids of durum wheat: D-genome addition and substitution lines. *In* S. Ramanujam (ed) Fifth Int. Wheat Genetics Sym., New Delhi, India. 1:420-426.

Joppa, L. R. and N. D. Williams. 1979. A disomic 5D-nullisomic-5B substitution line of durum wheat. *Crop Sci.* 19:509-511.

Quick, J. S., B. J. Donnelly, and J. D. Miller. 1979. Calvin--an improved semidwarf durum. *N. D. Farm Res. Bul.* 36, No. 6:19-23.

Quick, J. S., B. J. Donnelly, and J. D. Miller. 1979. Edmore--North Dakota's first strong gluten durum. *N. D. Farm Res. Bul.* 36, No. 6:14-18.

Quick, J. S., B. J. Donnelly, and J. D. Miller. 1979. Vic - high yielding, strong gluten durum. *N. D. Farm Res. Bul.* 37, No. 2:7-11.

#### Wooster, Ohio

Clements, R. L. 1979. Density fractionation of wheat flours in nonaqueous solvents. I. Effect of flour moisture level on distribution of solids, protein, and ash among fractions. *Cereal Chem.* 56(1):1-5.

Clements, R. L. 1979. Density fractionation of wheat flours in nonaqueous solvents. II. Behavior of fractions in water. *Cereal Chem.* 56(1): 6-10.



Kissell, L. T., J. R. Donelson, and R. L. Clements. 1979. Functionality in white layer cake of lipids from untreated and chlorinated patent flours. I. Effects of free lipids. *Cereal Chem.* 56(1):11-14.

Kissell, L. T. and N. Prentice. 1979. Protein and fiber enrichment of cookie flour with brewer's spent grain. *Cereal Chem.* 56(4):261-266.

Kissell, L. T. and W. T. Yamazaki. 1979. Cake-baking dynamics: relation of flour-chlorination rate to batter expansion and layer volume. *Cereal Chem.* 56(4):324-327.

Yamazaki, W. T., J. R. Donelson, and R. L. Clements. 1979. Note on the effect of bran lipids on cookie quality. *Cereal Chem.* 56(6):584-585.

#### Stillwater, Oklahoma

Gough, F. J. and N. Tuleen. 1979. Septoria leaf blotch resistance among Agropyron elongatum chromosomes in Triticum aestivum Chinese Spring. *Cereal Res. Comm.* 7:275-280.

Young, H. C., Jr., F. J. Gough, E. L. Smith, and E. E. Sebesta. 1979. Registration of a germplasm line of wheat. *Crop Sci.* 19:566.

#### Corvallis, Oregon

Metzger, R. J., C. W. Schaller, and C. R. Rohde. 1979. Inheritance of resistance to common bunt in wheat, C.I. 7090. *Crop Sci.* 19:309-312.

Ross, W., E. Possehl, and E. J. Trione. 1979. Spore germination inhibitors from teliospores of the dwarf bunt fungus of wheat, Tilletia controversa. *Phytopath.* 69:919.

Kollmorgen, J. F., W. M. Hess, and E. J. Trione. 1979. Ultrastructure of primary sporidia of a wheat-bunt fungus, Tilletia caries, during ontogeny and mating. *Protoplasma* 99:189-202.

#### University Park, Pennsylvania

Marshall, H. G. 1979. Studies of inbreeding depression, breeding behavior, and heterosis with inbred lines of buckwheat. *Crop Sci.* 19:110-114.

#### Brookings, South Dakota

Price, P. B. and J. G. Parsons. 1979. Distribution of lipids in embryonic-axis, bran-endosperm and hull fractions of hullless barley and hullless oat grain. *J. of Agric. Food Chem.* 27:813-815.

Parsons, J. G. and P. B. Price. 1979. Phospholipids of barley grain. *J. of Agric. Food Chem.* 27:913-915.

#### Beaumont, Texas

- Bollich, C. N., B. D. Webb, M. A. Marchetti, and J. E. Scott. 1980. Registration of Newrex rice (Reg. No. 54). Crop Sci. 20:286.
- Hodges, R. J., C. N. Bollich, M. A. Marchetti, and B. D. Webb. 1979. Rice varieties. Texas Agr. Ext. Serv., TAMU B-1239.
- Webb, B. D. 1979. Rice quality and grades. Chap. 15. In "Rice: production and utilization," edited by B. S. Luh, Avi. Publ. Co., Inc., Westport, CT. 543-565.
- Adkins, J. E. and M. A. Marchetti. 1979. Rice diseases. Farmers Bul. 2120, USDA. 19 pp. (Revised).

#### Logan, Utah

- Goates, B. J. and J. A. Hoffmann. 1979. Somatic nuclear division in Tilletia species pathogenic on wheat. Phytopath. 69:592-598.

#### Pullman, Washington

- Milus, E. A. and R. F. Line. 1980. Virulence of Puccinia recondita in the Pacific Northwest. Plant Disease 64:78-80.
- Bruinsma, B. L. and G. L. Rubenthaler. 1979. Estimation of lysine and texture in cereals by NIR. Proc. of the 8th Technicon Int. Cong., London, Dec. 12-14, 1978.
- Cook, R. J., J. W. Sitton, and J. T. Waldher. 1980. Evidence for Pythium as a pathogen of direct-drilled wheat in the Pacific Northwest. Plant Disease 64:102-103.
- Homma, Y., J. W. Sitton, R. J. Cook, and K. M. Old. 1979. Perforation and destruction of pigmented hyphae of Gaeumannomyces graminis by Vampyrellid amoebae from Pacific Northwest wheat-field soils. Phytopath. 69:1118-1122.
- Hsu, D., H. K. Leung, P. L. Finney, and M. M. Morad. 1980. Effects of germination on nutritive value and baking properties of dry peas, lentils, and faba beans. J. Food Sci. 45:87-92.
- Jeffers, H. C., G. Noguchi, and G. L. Rubenthaler. 1979. Effects of legume fortifiers on the quality of Udon noodles. Cereal Chem. 56(6):573-576.
- Lookhart, G. L., P. L. Finney, and K. F. Finney. 1979. Note on coumestrol in soybeans and fractions at various germination times. Cereal Chem. 56: 495-496.
- Cook, R. J. 1979. Influence of crops besides wheat on Gaeumannomyces graminis and take-all decline. Phytopath. 69:914.

Cook, R. J. and Y. Homma. 1979. Influence of water potential on activity of amoebae responsible for perforations of fungal spores. *Phytopath.* 69:914.

Cook, R. J. 1979. Water deficits and plant growth, Vol. V: Water and Plant Disease, edited by T. T. Kozlowski, Academic Press, NY. 1978. 323 pp. 3150. Book Review. *Bioscience* 29:425-426.

Madison, Wisconsin

Chinnici, M. F. and D. M. Peterson. 1979. Temperature and drought effects on blast and other characteristics in developing oats. *Crop Sci.* 19:893-897.

Prentice, N., W. C. Burger, and B. L. D'Appolonia. 1979. Rolled high lysine barley in breakfast cereal, bread and cookies. *Cereal Chem.* 56:413.

White, W. B., M. C. Sunde, H. R. Bird, W. C. Burger, and N. Prentice. 1979. Brewer's dried grains in laying mash. *Feedstuffs.* 51(8):27.



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## National Research Program 20060

### BREEDING AND PRODUCTION - COTTON

Cotton fiber, and food and feed from cottonseed are vital renewable national resources. Domestically produced cotton fiber reduces our dependence on petroleum based synthetics. The mission of this national research program is to develop new knowledge which will increase production efficiency and provide consumers with a stable supply of fiber and food at a reasonable cost. The research approaches emphasize genetic improvement and the development of more efficient cultural and management practices.

NPS Contact: P. A. Miller

#### Research Locations:

Auburn, Alabama  
Phoenix, Arizona  
Davis, California  
Shafter, California  
Mississippi State, Mississippi  
Stoneville, Mississippi  
Las Cruces, New Mexico  
Raleigh, North Carolina  
Florence, South Carolina  
Knoxville, Tennessee  
Brownsville, Texas  
College Station, Texas  
Lubbock, Texas  
Weslaco, Texas

Technological Objective 1: New and improved genetic populations, breeding lines, and varieties of cotton that combine increased yield potentials and favored quality characteristics of seed and lint with increased resistance to pests, tolerance to environmental stresses, and adaptation to modern cultural, harvesting and handling practices.

#### Examples of Recent Progress:

Regional Fusarium wilt test conducted - Auburn, Alabama. A regional Fusarium wilt test is conducted annually on heavily infested land near Auburn, AL. This test provides objective data to cooperating SEA-AR, State and private breeders for evaluating the comparative resistance of their experimental strains. Growers and the cotton industry benefit from the development and the release of commercial cotton varieties with improved resistance to Fusarium wilt.

Root-knot nematode resistant germplasm being developed - Auburn, Alabama. Germplasm has been identified in which the egg production of root-knot nematodes has been reduced to approximately 1-2% of that observed on currently grown varieties. Rapid progress is being made in combining this high resistance

with acceptable yield, agronomic and fiber characteristics. Varietal resistance would reduce or eliminate the need for applying costly and potentially polluting chemical nematicides.

Homozygous Pima pollen fertility restorer lines developed - Phoenix, Arizona. All component lines (A, B, and R lines) necessary for hybrid cotton production are now available within Pima cotton. The final component restorer line was isolated in the homozygous condition and gives 100% fertility restoration.

New Pima strain identified that is less adversely affected by delayed planting - Phoenix, Arizona. Delays in planting affect the yields of upland cotton much less than the yields of Pima cotton. Three years of testing showed date of planting to have little effect on the yield of upland cotton with normal September 1 final irrigation. Pima cotton yields were decreased with each delay in planting each year. A recently developed, early maturing Pima strain was included in the date of planting test for the first time in 1979. Its yield was much less reduced by planting delays than was commercial Pima S-5.

Host plant resistance technique developed for uniform infestation of *Heliothis virescens* - Mississippi State, Mississippi. A technique suitable for use by public and private plant breeding companies was field tested for evaluating large numbers of lines for resistance to *Heliothis virescens*. First instar larvae are mixed with corn cob grits or corn meal and placed in cotton terminals using the Davis modification on the CIMMYT larvae applicator. This is the first report of a large scale successful application of this method with *Heliothis virescens*.

Nectariless cottons have less yield losses due to early season insects than nectaried cottons - Stoneville, Mississippi. In a two-year study at three locations per year, the average lint yield of nectariless and nectaried cottons was 958 and 955 kg/ha, respectively, when early season insecticide applications were made. When no early season insecticides were applied, the average yield was 838 and 721, respectively, for nectariless and nectaried cottons.

High tannin breeding line with resistance to insects developed - Raleigh, North Carolina. A breeding line designated as F2-BR-1 with resistance to aphids, spider mites and bollworm has been selected. This cotton has a high level of condensed tannins in vegetative parts. Seed are being increased for a noncommercial germplasm release.

Nature of *Heliothis* resistance in Pee Dee cottons explored - Florence, South Carolina. Additional data support previous findings that about one-half as many damaged squares and live larvae are found on certain resistant Pee Dee breeding lines as on commercial varieties. However, preliminary chemical analysis of terminals and squares for terpenoids and condensed tannins do not reveal any significant difference in these compounds that could account for these observed genetic differences in resistance.

New interspecific hybrid may be useful for developing varieties with cleaner cotton - Knoxville, Tennessee. Embryo culture has made it possible to hybridize *Gossypium arboreum* with *G. armourianum*. The latter species is a wild cotton which sheds its bracts prior to boll opening. This deciduous bract trait, if incorporated into commercial varieties by crossing the new

hybrid with upland cotton, could eliminate bract trash in the harvested lint. Some medical researchers have also suggested that the bract trash may be implicated as a causal factor of byssinosis.

Short season breeding stocks developed - Brownsville, Texas. Breeding stocks with a high frequency of the "side-by-side" fruiting character averaged 20-35% higher in yield than current varieties at 120 days after planting. Fiber properties and boll size were equal to checked varieties.

Development of cottons with glanded foliage but with glandless seed - College Station, Texas. Pigment glands in cotton are important for host plant resistance to insects, but they seriously limit the uses of cottonseed as food and feed. Three hexaploid cottons that have glanded flower buds and leaves, but glandless seed, were developed by crossing wild Australian cottons with glandless cultivars of Upland cotton. The original crosses gave sterile progeny that were treated with colchicine to yield the fertile glanded foliage, glandless seed lines. Further crosses have been made to transfer this valuable character into agronomically desirable cottons.

Natural history of cotton summarized - College Station, Texas. The publication of *The Natural History of the Cotton Tribe* (Texas A&M University Press, pp. xviii+ 245. 1979) records the current state of knowledge of the taxonomy, evolution, ethnobotany, and agricultural history of the cottons and their immediate relatives. It is intended to provide a standard and guide for future studies in the agricultural and biological sciences, not only for cotton, but by analogy, for other crop plants as well.

Pubescent leaves confer a high degree of resistance to thrips injury - Lubbock, Texas. The pilose gene confers virtual immunity to leaf injury by thrips. Pubescent leaf strains exhibit normal leaf area development and yield in the presence of thrips without insecticide treatment. Untreated glabrous types showed a significant reduction in leaf area development and yield as compared to the same genotypes treated with a systemic insecticide at planting.

Bud gossypol level of 1.2% effective in reducing insects - Weslaco, Texas. Cotton strains that had a bud gossypol content in excess of 1.5% were compared to lines having 1.2% gossypol. These lines were subjected to moderate cotton fleahopper and *Heliothis* populations. However, the higher gossypol lines did not differ significantly from those with the lower amounts. It was concluded that the 1.2% is an effective concentration and a higher percentage does not further increase mortality.

Technological Objective 2: New and improved cultural and management practices that optimize yield potentials, minimize production losses, preserve quality attributes, and conserve and utilize resources efficiently.

Examples of Recent Progress:

Soft rot of squares may be caused by thrips - Phoenix, Arizona. Soft rot was reported last year to be one of the causes of square (floral bud) abscission. Soft rot has since been shown to be associated with feeding by thrips on the internal tissues of very young (pinhead) squares. This is the first time thrips have been implicated as a cause of square shedding in cotton. This is



significant because up to 30% of examined squares that were shedding were found to have soft rot symptoms. This definition of another cause of square shedding will aid in pinpointing the nature, causes and corrective measures needed in future outbreaks of severe square shedding which sometimes severely reduce cotton yields.

Techniques developed for isolating starch granules in pure form - Phoenix, Arizona. Cotton leaves contain large amounts of substances that interfere with enzymes, thus making enzymatic studies difficult. A simple procedure was developed in which starch grains with bound enzymes are cleanly and quickly separated from chloroplast fragments and other interfering substances. The starch granules are isolated by ultracentrifugation into a concentrated sucrose solution. This technique greatly facilitates investigation of granule-bound enzymes involved in starch metabolism.

Occurrence of the T-1 strain of Verticillium dahliae in areas outside the U.S. Cotton Belt - Davis, California. Laboratory evidence was obtained indicating that the highly virulent and important T-1 cotton strain of *V. dahliae* is present in elm and maple trees in the Midwest and in rosebush on the East Coast. These findings change earlier thinking on the origin and perpetuation of this pathogen which was thought to be present primarily in the U.S. Cotton Belt.

Improved seed and seedling protection in soils infested with Pythium ultimum, Rhizoctonia solani, and Thielaviopsis basicola - Shafter, California. Combinations of fungicides containing a control for Pythium performed very well in early plantings. In identical trials planted at later dates, controls for Rhizoctonia provided relatively better protection to seedlings. The results were predicted based on population assays of this soil for the test pathogens. No single chemical is adequate to provide protection. By combining selected chemicals we can obtain adequate populations of plant seedlings.

Narrow row short season cotton production system profitable at grower level - Shafter, California. Net income may be more than \$40.00 per hectare greater in an agricultural system that includes a shorter season cotton production system in place of the conventional long season cotton. Improved lint yields, earlier once-over harvest, more appropriate preparation for succeeding crops and yields therefrom were included in the benefits.

Short season cotton system improves pest management in the Imperial Valley - Shafter, California. A narrow row system with rows spaced 51 centimeters apart was harvested and the stalks destroyed in early September. Diapausing (overwintering) pink bollworm pupae were reduced 60% and the spring emergence of moths was reduced 90%. The short season production technique eliminated feeding sites of the pink bollworm before the pest was prepared for the overwintering stage of its annual life cycle.

Plant growth regulator investigated to modify Delta varieties for stripper harvest - Stoneville, Mississippi. Pix<sup>R</sup> treated Stoneville 213 plants were 28% shorter than controls and had a similar reduction in fruiting branch length. The grade index of the stripper cotton was increased from 69 in the control to 85 in the Pix<sup>R</sup> treatment. Defoliation was more complete in the Pix<sup>R</sup> plots and may account for much of the grade difference. Grade index of spindle picked cotton was 100 in both treated and controlled plots. The amount of



crop gathered at first harvest with the spindle picker was increased by 15% in the Pix<sup>R</sup> plots. The stripper plots were harvested three weeks before the spindle picker harvest was complete. Lint yield was not affected by either treatment or harvest method.

Biological control of seedling diseases in cotton - College Station, Texas

A bacterium with broad potential for control of seedling diseases was isolated from the surface of healthy cotton plants. The bacterium, the PF-5 isolate of Pseudomonas fluorescens, strongly inhibits the growth of most soil-borne fungal pathogens that attack cotton and other field crops. Two antibiotics produced by the bacterium have been identified and are responsible for the bacterium's antagonism to pathogenic fungi. Treatment of cottonseed with the live bacterium for its antibiotics greatly increases the stand and vigor of cotton seedlings grown in soil and infested with disease organisms.

COTTON NONCOMMERCIAL GERMPLASM RELEASED 1979

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
Pima 79-103 Pima 79-106	SEA-AR, Phoenix, AZ and the Arizona AES, Tucson, AZ	Early maturing, short statured strains which may be suitable parents for use in interspecific hybrid cotton production.
Earlistaple 7 FJA FTA Hybrid 330 Sealand 542	SEA-AR, Florence, SC and the South Carolina AES, Clemson University, Clemson, SC	These stocks represent distinctive early stages of progress in combining high lint yield and extra fiber strength.

## P U B L I C A T I O N S

### Auburn, Alabama

- Jenkins, J. N., J. C. McCarty, W. L. Parrott, and A. J. Kappelman, Jr. 1979. Registration of 11 cotton germplasm (Req. No. GP 53 to GP 63). Crop Sci. 19:932.
- Jenkins, J. N., J. C. McCarty, W. L. Parrott, and A. J. Kappelman, Jr. 1979. Germplasm release of Fusarium wilt resistant noncommercial stocks of cotton involving Gossypium hirsutum L. race accessions. Miss. Agric. & Forestry Expt. Sta. Res. Rpt., Vol. 4, No. 20.
- Jenkins, J. N., W. L. Parrott, A. J. Kappelman, Jr., and Raymond L. Shepherd. 1979. Registration of JPM-781-78-3 cotton germplasm (Reg. No. GP 52). Crop Sci. 19:932.
- Kappelman, A. J., Jr. 1979. Regional Cotton Fusarium Wilt Test Results. Dept. of Agron. & Soils Depart. Series No. 52. Agric. Expt. Sta., Auburn University.
- Kappelman, A. J., Jr., J. N. Jenkins, and W. L. Parrott. 1979. Fusarium wilt resistance in day-neutral selections from primitive races of cotton and crosses of race selections with a commercial cultivar. Crop Sci. 19: 795-798.
- Shepherd, Raymond L. 1979. A quantitative technique for evaluating cotton for root-knot nematode resistance. Phytopathology 69:427-430.

### Phoenix, Arizona

- Bariola, L. A., T. J. Henneberry, and D. L. Kittock. 1979. Status of chemical termination of cotton plant fruiting as a means for controlling the pink bollworm and boll weevil. Proc. 1979 Beltwide Cotton Prod. Res. Confs.: 130-132.
- Beasley, C. A., M. A. Egli, S. R. Chang, and J. W. Radin, 1979. Independent control of fiber development and nitrate reduction in cultured cotton ovules. Plant Physiol. 63: 57-60.
- Chang, C. W. 1979. Isolation and purification of leaf starch components. Plant Physiol. 64: 833-36.
- Chang, C. W. 1979. Determination of  $\alpha$ -amylase activity from cotton leaves with amylopectin-azure. Microchemical Journal 24: 50-55.
- Chang, C. W. 1979. Starch and its component ratio in developing cotton leaves. Plant Physiol. 63: 973-977.
- Cherry, J. P., J. G. Simmons, R. J. Kohel, H. B. Cooper, M. Lehman, J. Dobbs, K. E. Fry, D. L. Kittock, and T. J. Henneberry. 1979. Relationship of cotton seed quality to genetic and agronomic practices. The Cotton Gin and Oil Mill Press. (March 24, 1979) 18-21.



- Farr, C. R., and D. L. Kittock. 1979. Effect of date of irrigation termination on yield of upland and Pima cotton. Proc. 1979 Beltwide Cotton Prod. Res. Confs.:95-97.
- Feaster, C. V., J. E. Ross, E. L. Turcotte and C. K. Bragg. 1979. Effects of fiber length uniformity on processing Pima cotton. USDA, Production Research Report No. 176, 11 pages.
- Guinn, G. 1979. Hormonal relations in flowering, fruiting, and cutout. In: J. McD. Stewart, ed., Cotton Physiology - A Treatise, Section 1, Flowering, fruiting and cutout. Proc. 33rd Cotton Physiol. Conf., pp. 265-76.
- Guinn, G. and J. R. Mauney. 1980. Analysis of CO<sub>2</sub> exchange assumptions; Feedback control. In: J. D. Hesketh, ed., Predicting Photosynthesis for Ecosystem Models, Ch. 1, Vol. 2 CRC Press, Boca Raton, Florida. pp. 1-16.
- Henneberry, T. J., D. L. Kittock, L. A. Bariola, and B. A. Kimball. 1979. Application of a computer model to simulate effects of chemical termination of late-season cotton fruiting on diapause pink bollworm populations. The Southwestern Entomol. 4:231-234.
- Henneberry, T. J., W. G. Hart, L. A. Bariola, D. L. Kittock, H. F. Arle, M. R. Davis, and S. J. Ingle. 1979. Parameters of cotton cultivation from infrared aerial photography. Photogrammetric Eng. and Remote Sensing. 45:1129-1133.
- Kittock, D. L., L. L. H. Pinkas, and K. E. Fry. 1979. Branch node location and competition effects on yield components of Pima cotton bolls. Proc. 33rd Cotton Physiol. Conf., pp. 53-56.
- Kittock, D. L. 1979. Pima and upland cotton response to irrigation management. Agron. J. 71:617-619.
- Kittock, D. L., T. J. Henneberry, and L. A. Bariola. 1979. Chemical termination for insect control in cotton: past, present, and future. Proc. 1979 Beltwide Cotton Prod. Res. Confs.:62-64.
- Kittock, D. L., L. L. H. Pinkas, and K. E. Fry. 1979. Branch node location and competition effects on yield components of Pima cotton bolls. Proc. 1979 Beltwide Cotton Prod. Res. Confs.:53-56.
- Mauney, J. R. 1979. Production of fruiting points. In: J. McD. Stewart, ed., Cotton Physiology - A Treatise, Section 1, Flowering, fruiting and cutout. Proc. 33rd Cotton Physiol. Conf., pp. 256-61.
- Mauney, J. R. and T. J. Henneberry. 1979. Identification of damage symptoms and pattern of feeding of plant bugs in cotton. J. Econ. Ent. 72:496-501.
- Mauney, J. R., G. Guinn, K. E. Fry, and J. D. Hesketh. 1979. Correlation of photosynthetic carbon dioxide uptake and carbohydrate accumulation in cotton, soybean, sunflower, and sorghum. Photosynthetica 13:260-66.
- Radin, J. W., and C. D. Elmore. 1979. Concepts of translocation with special reference to the assimilation of nitrogen and its movement into fruits. In: J. D. Hesketh, ed., Predicting Photosynthesis for Ecosystem Models. Chemical Rubber Co. Press, West Palm Beach, Florida. Vol. 2, pp. 143-154.

Radin, J. W. 1979. A relationship between nitrogen nutrition and water use in cotton. Proc. 1979 Beltwide Cotton Res. Conf. pp. 305-306.

Radin, J. W., and L. L. Parker. 1979. Water relations of cotton plants under nitrogen deficiency. I. Dependence upon leaf structure. Plant Physiol. 64:495-498.

Radin, J. W., and L. L. Parker. 1979. Water relations of cotton plants under nitrogen deficiency. II. Environmental interactions on stomata. Plant Physiol. 64:499-501.

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El Zik, K. M. and V. T. Walhood. 1979. Short Season Cotton in the San Joaquin Valley of California, Proc. West. Prod. Conf. pp. 51-53.

El-Zik, K. M. and V. T. Walhood. 1979. A Study Guide for PCA's on Defoliation and Other Harvest Aid Practices. U.C. Pub. 403. 34 pp.

Hyer, A. H., E. C. Jorgenson, R. H. Garber, and S. Smith. 1979. Resistance to root knot nematode in control of root knot nematode Fusarium wilt complex in cotton. Crop Science 19:989-901.

Kepner, R. A., R. G. Curley, C. R. Brooks and V. T. Walhood. 1979. A Brush Type Stripper for Double Row Cotton. Am. Soc. Agric. Eng. Vol. 22, No. 6, pp. 1234-1237.

Pullman, G. S., J. E. DeVay and R. H. Garber. 1979. Plastic tarping: an effective control for Verticillium wilt of cotton. Proc. Beltwide Cotton Prod. Conf. Page 25.

Pullman, G. S., J. E. DeVay and R. H. Garber. 1979. Chapter in book. Soil-Borne Plant Pathogens. B. Schippers & W. Gans (Acad. Press) 686 pp. Chapter 39, pp. 439-446.

Tabachnik, M., J. E. DeVay, R. H. Garber and R. J. Wakeman. 1979. Influence of soil inoculum concentrations on host range and disease reactions caused by isolates of Thielaviopsis basicola and comparison of soil assay methods. Phytopath. 69:974-976.

Walhood, V. T. 1979. Short Season Cotton in the Imperial Valley with Special Reference to Pest Management. Proc. West. Cotton Prod. Conf. El Paso, TX. Pages 48-51.

Mississippi State, Mississippi

Jenkins, Johnie N., J. C. McCarty, Jr., W. L. Parrott, and R. G. Creech. 1979. Germplasm release of 81 F<sub>5</sub> flowering lines of cotton involving 54 Gossypium hirsutum L. race accessions. MAFES Bulletin 881, 6 pages, October 1979.

Jenkins, Johnie N., J. C. McCarty, Jr., R. G. Creech, W. L. Parrott. 1979. Registration of 77 cotton germplasms. Crop Science 19:933-934.

Jenkins, Johnie N., J. C. McCarty, Jr., W. L. Parrott, and A. L. Kappelman. 1979. Germplasm release of Fusarium wilt-resistant, noncommercial stocks of cotton involving Gossypium hirsutum L. race accession. MAFES Research Report Vol. 4, No. 20, 4 pages.

Jenkins, Johnie, N., J. C. McCarty, Jr., W. L. Parrott, and A. L. Kappelman. 1979. Registration of 11 cotton germplasms. Crop Science 19:932-933.

Jenkins, Johnie N., W. L. Parrott, A. L. Kappelman, and Raymond Shepherd. 1979. Germplasm release of a noncommercial stock of cotton Gossypium hirsutum L. with resistance to Fusarium wilt and Lygus lineolaris. MAFES Research Report Vol. 5, No. 2.

Jenkins, Johnie N., W. L. Parrott, A. J. Kappelman, and Raymond Shepherd. 1979. Registration of JPM-781-78-3 cotton germplasm. Crop Science Vol. 19:932.

Kappelman, A. L., Johnie N. Jenkins, and W. L. Parrott. 1979. Fusarium wilt resistance in day-neutral selections from primitive races of cotton and crosses of race selections with a commercial cultivar. Crop Science 19:795-798.

McCarty, J. C., J. N. Jenkins, W. L. Parrott, and R. G. Creech. 1979. The conversion of photoperiodic primitive race stocks of cotton to day-neutral status. Mississippi Agricultural and Forestry Experiment Station Research Report Vol. 4 No. 19, 4 pages.



### Stoneville, Mississippi

Cathey, G. W., and R. O. Thomas. 1979. Exogenous modifications of flowering, fruiting and cutout. Cotton Physiology - A Treatise, Section I. Proc. Beltwide Cotton Prod. Res. Conf. 33: 277-78.

Cathey, George W. 1979. Acceleration of boll dehiscence with desiccant chemicals. Agron. J. 71: 505-510.

Culp, T. W. and W. R. Meredith, Jr. 1979. Does your cotton variety run out? Beltwide Cotton Production-Mechanization Conference pp. 56-57.

Hanny, B. W., J. C. Bailey, and W. R. Meredith, Jr. 1979. Yellow cotton pollen suppresses growth of larvae of tobacco budworm. Environ. Entomol. 8: 706-707.

King, E. E., and H. R. Leffler. 1979. Nature and patterns of proteins during cotton seed development. Plant Physiol. 63: 260-3.

King, E. E., and H. R. Leffler. 1979. Cottonseed protein: its status and potential for improvement. In: Seed Protein Improvement in Cereals and Grain Legumes, Vol. II, pp. 385-91. International Atomic Energy Agency, Vienna.

Leffler, H. R. 1979. Physiology of earliness. Proc. Beltwide Cotton Prod. Res. Conf. pp. 264-5.

McMichael, B. L. 1979. The influence of plant water stress on flowering and fruiting in cotton. Proc. Beltwide Cotton Prod. Res. Conf. pp. 301-302.

Meredith, W. R., Jr. 1979. Inbreeding depression of selected F<sub>3</sub> cotton progenies. Crop Sci. 19: 86-88.

Meredith, W. R., Jr. and M. F. Schuster. 1979. Tolerance of glabrous and pubescent cottons to tarnished plant bugs. Crop Sci. 19: 484-488.

Meredith, W. R., Jr., V. G. Meyer, B. W. Hanny, and J. C. Bailey. 1979. Influence of five Gossypium species cytoplasms on yield, yield components, fiber properties, and pest resistance. Crop Sci. 19: 647-650.

Meredith, W. R., Jr., B. W. Hanny, and J. C. Bailey. 1979. Genetic variability among glandless cottons for resistance to two insects. Crop Sci. 19: 651-653.

Meredith, W. R., Jr. and T. W. Culp. 1979. Influence of cotton cultivars longevity of use on performance. Crop Sci. 19: 654-656.

Thomas, R. O., T. C. Cleveland, and G. W. Cathey. 1979. Chemical plant growth suppressants for reducing late-season cotton bollworm-budworm feeding sites. Crop Sci. 19: 861-63.

### Las Cruces, New Mexico

No publications.

### Raleigh, North Carolina

No publications.

### Florence, South Carolina

Culp, T. W., and D. C. Harrell. 1979. Registration of SC-1 cotton. Crop Sci. 19: 410.

Culp, T. W., D. C. Harrell, and T. Kerr. 1979. Some genetic implications in the transfer of high fiber strength genes to upland cotton. Crop Sci. 19: 481-484.

Culp, T. W. 1979. Registration of Pee Dee 695 and Pee Dee 875 germplasm line of cotton. Crop Sci. 19: 751.

Culp, T. W., and D. C. Harrell. 1979. Registration of five germplasm lines of cotton. Crop Sci. 19: 751-752.

Culp, T. W., and D. C. Harrell. 1979. Registration of Pee Dee 4461 cotton germplasm. Crop Sci. 19: 752.

Culp, T. W., and D. C. Harrell. 1979. Registration of Pee Dee 6520 germplasm line of cotton. Crop Sci. 19: 752-753.

Culp, T. W., and D. C. Harrell. 1979. Registration of Pee Dee 8619 germplasm line of cotton. Crop Sci. 19: 753.

Culp, T. W., A. R. Hopkins, and H. M. Taft. 1979. Breeding insect resistant cotton in South Carolina. S. C. Agric. Exp. Stn. Techn. Bull., p. 1074.

Culp, T. W., and W. R. Meredith, Jr. 1979. Does your variety run out? Proc. Beltwide Cotton Prod. Res. Conf., Spec. Session, Nat'l Cotton Council, pp. 56-57.

Harrell, D. C., and T. W. Culp. 1979. Registration of Pee Dee 0259 and PD 2165 germplasm lines of cotton. Crop Sci. 19: 418.

Harrell, D. C., and T. W. Culp. 1979. Registration of Pee Dee 4381 germplasm line of cotton. Crop Sci. 19: 418

Meredith, W. R., Jr., and T. W. Culp. 1979. Influence of longevity of use of cotton cultivars performance. Crop Sci. 19: 654-656.

### Knoxville, Tennessee

Duckett, K. E., B. C. Goswami, and H. H. Ramey, Jr. 1979. Mechanical properties of cotton/polyester yarns. Part I. Contribution of interfiber friction to breaking energy. Textile Research Journal 49: 262-267.

Krowicki, R. S. and K. E. Duckett. 1979. A re-examination of determination of the mass of cotton fibers by means of optical and geometrical measurements. Journal of the Textile Institute 70: 78-80.

Lawson, R., H. H. Ramey, Jr. and J. B. Jones. 1979. Relation of cotton fiber maturity and strength uniformity to change in tenacity with mercerization. Textile Research Journal 49: 433-437.

Ramey, H. H., Jr., J. H. Turner, Jr. and R. S. Krowicki. 1979. Regional Cotton Variety Tests, 1973. Science and Education Administration, U. S. Department of Agriculture.

Smith, C. W., B. A. Waddle, and H. H. Ramey, Jr. 1979. Plant Spacings with irrigated cotton. Agronomy Journal 71: 858-860.

Stewart, J. M. 1979. Cotton Physiology - A Treatise, Preface Proceedings 1979 Beltwide Cotton Production Research Conferences. P. 256.

Stewart, J. M. 1979. Use of ovule culture to obtain interspecific hybrids of Gossypium. In: Plant Tissue Culture. J. T. Barber (Ed) Symposium, Sou. Sec. Am. Soc. Pl. Physiologists.

Turner, J. H., Jr., S. Worley, Jr., H. H. Ramey, Jr., P. E. Hoskinson and J. M. Stewart. 1979. Relationship of week of flowering and parameters of boll yield in cotton. Agronomy Journal 71: 248-251.

#### Brownsville, Texas

Namken, L. N., M. D. Heilman, and R. H. Dilday. 1979. Arrangement of sympodia and earliness potential in cotton. Crop Sci. 19: 620-22.

Wolfenbarger, D. A., R. H. Dilday, and A. W. Hartstack, Jr. 1979. Boll weevil: Relationship of predicted vs. observed peaks of populations to squaring rates of two cotton cultivars. Environ. Entomol. 8: 506-11.

Wolfenbarger, D. A., R. H. Dilday, and J. W. Davis. 1979. Fruiting requirements of short-season cottons to avoid damage by the boll weevil in the Lower Rio Grande Valley. Proc. Beltwide Cotton Prod. Res. Conf., pp. 88-90.

#### College Station, Texas

Bell, A. A. 1979. Review of the research program at the USDA National Cotton Pathology Research Laboratory. IX International Congress of Plant Protection.

Elissalde, M. H., Jr., and Greenblatt, G. A. 1979. The role of cyclic AMP and cyclic GMP in byssinosis. Am. Ind. Hyg. Assoc. J. 40: 1067-1074.

Fryxell, P. A. 1979. Taxonomic research and plant germplasm collections. USDA-SEA Agric. Rev. Man. S-4, pp. 1-6.

Fryxell, P. A. 1979. The natural history of the cotton tribe. Texas A&M University Press: College Station and London. xviii+245 pp.

Fryxell, P. A. and Koch, S. D. 1978. A range extension of Gossypium lobatum Gentry (Malvaceae) from Michoacan, Mexico. Southwestern Naturalist 23(4): 708-709.

Greenblatt, G. A., and Ziprin, R. L. 1979. The effect of cotton bract extracts on alveolar macrophage metabolism. Special Session on Cotton Dust, Proc. Beltwide Cotton Prod. Res. Conf., Phoenix, AZ, pp. 17-18, National Cotton Council, Memphis, TN.



Greenblatt, G. A., and Ziprin, R. L. 1979. Endotoxin-induced histamine hypersensitivity in mice...a model system for byssinosis? Am. Ind. Hyg. Assoc. J. 40:74-77.

Greenblatt, G. A., and Ziprin, R. L. 1979. Inhibition of luminol-dependent chemiluminescence of alveolar macrophages by possible etiological agents of byssinosis. Am. Ind. Hyg. Assoc. J. 40:860-865.

Halloin, J. M., and Bell, A. A. 1979. Production of nonglandular terpenoid aldehydes within diseased seeds and cotyledons of Gossypium hirsutum L. J. Agric. Food Chem. 27:1407-1409.

Hanks, S. and Fryxell, P. A. 1979. Palynological studies of Gaya and Herissantia (Malvaceae). Amer. J. Bot. 66:494-501.

Howell, C. R., and R. D. Stipanovic. 1979. Control of Rhizoctonia solani on cotton seedlings with Pseudomonas fluorescens and with an antibiotic produced by the bacterium. Phytopathology 69:480-482.

Kohel, R. J. 1979. Gene arrangement in the duplicate linkage groups V and IX: nectariless, glandless, and withering bract in cotton (Gossypium hirsutum L.). Crop Sci. 19(6):831-833.

Kohel, R. J. 1979. Potential of seed quality research - geneticist's viewpoint. Proc. 28th Oilseed Process. Clinic, New Orleans, LA.

Puhalla, J. E. 1979. Classification of isolates of Verticillium dahliae based on heterokaryon incompatibility. Phytopathology 69:1186-1189.

Quisenberry, J. E. and Kohel, R. J. 1979. Inheritance of boll growth traits in upland cotton. Proc. Beltwide Cotton Prod. Res. Conf. pp. 74-76.

Stipanovic, R. D., O'Brien, D. H., Rogers, C. E., and Thompson, T. E. 1979. Diterpenoid acids, (-)-cis- and (-)-trans-ozic acid, in wild sunflower, Helianthus occidentalis. J. Agric. Food Chem. 27:458-459.

Wheeler, M. H. and Stipanovic, R. D. 1979. The effects of tricyclazole on melanin biosynthesis in Thielaviopsis basicola. Proc. 37th Ann. Meeting of the Electron Microscopy Soc. Amer., San Antonio, TX pp. 268-269.

Wheeler, M. H. and Stipanovic, R. D. 1979. Melanin biosynthesis in the fungus Thielaviopsis basicola. Exp. Mycol. 3:340-350.

#### Lubbock, Texas

Dilbeck, R. E. and J. E. Quisenberry. 1979. Stormproof boll in upland cotton. I. Development of instrumentation and an inheritance study. Crop Sci. 19:567-571.

Minton, E. B., J. R. Gipson, and J. E. Quisenberry. 1979. Effects of controlled night temperatures on incidence of Verticillium wilt in field-grown cotton. Phytopathology 69:977-979.

Quisenberry, J. E., Bruce Roark, J. D. Bilbro, and L. L. Ray. 1978. Natural selection in a bulked hybrid population of upland cotton. Crop Sci. 18: 799-801.

Quisenberry, J. E. and R. J. Kohel. 1979. Inheritance of boll growth traits in upland cotton. Proc. Beltwide Cotton Prod. Res. Conf. pp. 74-76.

Quisenberry, J. E. and D. R. Rummel. 1979. Genotypic resistance to thrips injury in cotton as measured by differential leaf area reduction. Crop Sci. 19:849-851.

Rummel, D. R. and J. E. Quisenberry. 1979. Influence of thrips injury on leaf development and yield of various cotton genotypes. J. Econ. Entomol. 72:706-709.

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## National Research Program 20080

### BREEDING AND PRODUCTION - SOYBEANS, PEANUTS, AND OTHER OILSEED CROPS

This National Research Program involves research to improve agricultural production efficiency by developing new and improved plant genetic resources and cultural and management practices for soybeans, peanuts, sunflower, flax, safflower, and guar. Plant geneticists, agronomists, plant pathologists, plant physiologists, microbiologists, chemists, entomologists, and soil scientists (both Federal and State) work in a team approach to evaluate and improve oilseeds and improve cultural methods.

NPS Contact: R. C. Leffel

Technological Objective 1: New and improved genetic populations, breeding lines, and varieties of oilseed crops that combine improved yield potentials and favored quality characters, including reduced contents of undesirable constituents, with better resistance to pests, tolerance to environmental stress, and adaptation for mechanized culture, harvesting, and handling.

#### Research Locations:

Davis, California  
Gainesville, Florida  
Tifton, Georgia  
Urbana, Illinois  
West Lafayette, Indiana  
Ames, Iowa  
Beltsville, Maryland  
Stoneville, Mississippi  
Columbia, Missouri  
Raleigh, North Carolina  
Fargo, North Dakota  
Wooster, Ohio  
Stillwater, Oklahoma  
Brookings, South Dakota  
Bushland, Texas  
Suffolk, Virginia

#### Examples of Recent Progress:

##### Soybeans:

Greenhouse test developed for tolerance to boron - Davis, California.  
Maturity groups 00, 0, I, II, III, and IV of the USDA World Soybean Collection were screened in the field at West Side Field Station for tolerance to boron. A greenhouse test, utilizing Hoagland's solution plus

addition of  $H_3BO_3$  from zero to five ppm, and requiring 6 to 8 weeks, confirms Guelph as a tolerant variety; Williams, Amsoy 71, and Evans are susceptible.

High yielding, root-knot nematode resistant variety developed for southern U.S. - Gainesville, Florida. Braxton, a Maturity Group VII variety, was released for the southern U.S. where cyst nematode is not a problem. Braxton is resistant to two species of root-knot nematode and yields 10 percent more than Bragg which was grown on 5 1/2 million acres in the U.S. in 1979.

Phytophthora - resistant versions of Williams and Corsoy developed - Urbana, Illinois. Using the backcross method, a gene for resistance to 7 races of Phytophthora root rot was transferred to two widely grown varieties, Williams of Group III Maturity and Corsoy of Group II. By their resistance to most races of this most damaging root rot, Williams 79 and Corsoy 79 should appreciably increase the stability of soybean yields.

Semi-determinate variety developed especially for irrigation - Urbana, Illinois. Using the backcross method, a gene for a somewhat more determinate stem ( $Dt_2$ ) was transferred to the Williams variety. It produced a variety, Will, that was shorter and more lodging resistant than Williams, about 6 days earlier in maturity, often with better seed quality and higher yields than comparable varieties under some conditions, especially under irrigation.

Germplasm collection and utilization - Urbana, Illinois. New introductions received in 1979 numbered 1570 from U.S.S.R., 22 from PRC, and 8 from South Korea; 1865 plots of new introductions were grown. Research coordinated among 30 soybean breeders evaluated 2400 yield plots of Plant Introductions as part of a continuing program of germplasm evaluation. More than 1000 entries from the germplasm collection were evaluated for reaction to infection by soybean mosaic virus (SMV). One line, Suweon 97, was resistant to each of 7 isolates of SMV tested. Three hundred and sixty seven individual seed requests were filled from 38 states and 23 foreign countries.

Models for estimation of yield reduction by Septoria brown spot developed - Urbana, Illinois. Two linear regression models for the estimation of yield reduction in soybeans caused by Septoria brown spot were developed based on values of area under brown spot progress curves (AUBSC) and on severity at the R6 growth stage: 1)  $Y = 11.49 + 0.09X$ ; where  $Y = \% \text{ yield reduction}$  and  $X = \text{AUBSC values}$ : 2)  $Y = 8.33 + 0.32X$ ; where  $Y = \% \text{ yield reduction}$  and  $X = \text{brown spot severity at the R6 stage}$ .

Phytophthora - resistant version of Beeson developed - West Lafayette, Indiana. Using the backcross method, a gene for resistance to 7 races of Phytophthora root rot was transferred to Beeson, a Group II variety. Beeson 80 will increase the stability of soybean yields by its resistance to most races of this damaging root rot.

New high yielding, lodging resistant soybean developed - West Lafayette, Indiana. In tests conducted throughout the Midwest in 1978 and 1979, Century was the highest yielding Group II variety evaluated and it had better resistance to lodging than all other varieties except Wells II.

New soybean varieties 25 percent higher in yield than old varieties - West Lafayette, Indiana. Performance of currently grown varieties was compared with that of varieties grown 40 to 50 years ago in Illinois, Indiana, Iowa, and Ohio, in 1975 and 1976. Currently grown varieties averaged 25 percent higher seed yields than the old varieties when grown under the same management system. This increase in seed yield can be attributed to genetic improvement of the yield potential of the new varieties.

Coordination of Uniform Tests for Northern States provides new varieties - West Lafayette, Indiana and cooperating agencies. A total of 232 soybean strains and varieties were evaluated in 139 tests in the Northern States. Based on data from these tests, the varieties Maple Presto (00); Weber (I); Amcor, Beeson 80, Century, Corsoy 79, Gnome, Nebsoy (II); BSR 301, Pella, Will, Williams 79 (III); and Desota (IV) were released for certified seed production in 1980. (Varieties developed by AR scientists described elsewhere in this report).

Up to 25 percent of the total amino acid sequences of acidic subunits of glycinin determined - West Lafayette, Indiana. The essential structural feature of the acidic and basic subunits of storage protein glycinin are being determined. Up to 25 percent of the total amino acid sequences of the six acidic subunits were determined. Comparison of sequences: (1) showed how many methionine residues were present in each molecule and where they were located; (2) established that the six molecules had extensive regions of sequence homology; (3) indicated they were the products of a family of homologous structural genes; and (4) suggested there are 2-3 internal sequence repeats per molecule. These data constitute the most complete set of structural information about any of the seed storage proteins.

Germplasm with improved seed quality characteristics - West Lafayette, Indiana. Evaluations of soybean lines (Plant Introductions and Northern States Uniform Test lines) for seed quality have identified additional germplasm with resistance to pod and stem blight, purple stain, seed mottling, and weather damage. Seed quality of recently released determinate cultivars appears to be better than that of indeterminate cultivars in production in the Midwest.

First variety resistant to brown stem rot developed - Ames, Iowa. Brown stem rot is a widespread disease of soybeans causing greatest losses in seasons with a cool period at pod filling followed by hot, dry weather. The resistance found in PI 84946-2 was incorporated into improved germplasm to produce BSR 301, the first U.S. improved variety with resistance to the disease.



Soybean and Rhizobium coevolve - Beltsville, Maryland. Over 800 Asian soybean lines in the Germplasm Collection were tested for presence of Rj2 and Rj4 alleles which condition ineffective nodulation. A geographic pattern in gene frequency indicates that coevolution of ecotypes of host plant and of Rhizobium are of great significance in determining the effectiveness of the combinations of host genotypes with individual rhizobial strains. Simultaneous collection of both host and micro-symbiont germplasm from the Asian sources of origin is necessary for optimal future progress.

Herbicide resistant soybean developed - Stoneville, Mississippi. Tracy soybean is one of the most productive varieties for more than 5 million acres of slowly drained soils in the South, but is sensitive to the widely used herbicide, metribuzin. Tracy-M was developed from Tracy, is similar in productivity to Tracy, but is tolerant to metribuzin.

Specific genes for disease resistance do not restrict yield in absence of disease - Stoneville, Mississippi. Two genes for resistance to phytophthora root rot were transferred to a very susceptible line by backcrossing. In a disease environment, the addition of resistance genes to the susceptible recurrent parent resulted in seed yield increases of 20 to 100 percent. In a non-disease environment, no deleterious restrictions on yield were imposed by the addition of resistance genes.

Yield and protein of seed increased concurrently by breeding - Raleigh, North Carolina. A negative relation between yield and percent protein of seed is frequently observed in soybeans. This trend was reversed in one of two populations when selection for protein resulted in increased leaf area and weight; seed yield and protein increased. These data suggest that both translocation and accumulation of nitrogen was greater in the selected population. These results indicate that plant breeders can increase seed yield without diminishing protein levels.

Differences among soybean genotypes in rate of pod development - Raleigh, North Carolina. A study shows that soybean genotypes can be characterized with respect to rate of pod development. Differences among 18 genotypes ranged from 10 to 14 mg/pod/day. The correlation between pod development rate for a plot and the plot seed yield was .18. The results showed that development rates can be established by picking a random 50 pods in plots of a replicated test at the beginning, middle and end of pod-fill.

The role of phospholipids in polyunsaturated fatty acid synthesis - Raleigh, North Carolina. The nature of linoleic and linolenic acid biosynthesis in plant tissues has been debated for a number of years. It is generally accepted that oleic acid is the precursor of both linoleic and linolenic acids. However, the exact mechanism is a controversial subject. Two different pathways have been proposed. Oleic acid may be desaturated as an acyl-CoA or acyl-phospholipid intermediate. Although the existence of an acyl CoA pathway was not ruled out, in soybeans pulse-chase analysis of the metabolism of oleic acid incorporated into phospholipids supported a mathematical model that phospholipids are substrate intermediates for the synthesis of polyunsaturated fatty acids in developing soybeans. This finding provided important ramifications to the concept of polyunsaturated acyl synthesis in soybeans.



Improvement of soybean oil quality by reducing linolenic acid - Raleigh, North Carolina. Clear cut evidence was obtained from the analysis of large populations of homozygous selected material that the genetic methods employed to reduce linolenic acid content in soybean oil were effective and warranted continued efforts to develop germplasm that contains 3% linolenic acid. High levels of linolenic acid are associated with unstable oil flavor quality. Projected implications of the development of a low linolenic acid soybean oil suggest an enhanced cost-benefit realization to the soybean oil processing industry and ultimately to consumers of soybean oil products.

Immunity to bean pod mottle virus - Raleigh, North Carolina. Yields of three cultivars artificially inoculated with bean pod mottle virus were reduced 0, 7.5, and 12.1 percent. About 2000 Plant Introductions of Group IV maturity were evaluated for resistance or immunity to the disease. One line was identified as having no symptoms of the virus.

Varieties developed for specific environments - Wooster, Ohio. Gnome is a late maturity group II determinate semidwarf variety, developed specifically for high yield environments and solid seeded production. It should move the area of adaptation for semidwarf varieties further north. Amcor is a very tall group II variety which has shown good adaptation to low yield environments where its greater plant height results in higher yields than currently grown varieties. It also appears to be well adapted to double cropping. These two varieties should make a significant contribution to Midwest and Eastern soybean yields.

#### Peanuts:

Development of peanuts resistant to *Aspergillus flavus* progresses - Tifton, Georgia. Advanced selections from crosses between genotypes resistant to aflatoxin-producing strains of *Aspergillus* spp. and highly productive genotypes are being evaluated for yield and market-grade potential. These lines have survived very drastic laboratory screening from 2 to 8 generations, depending upon the selection. A highly productive line 'A 7109', is currently receiving additional critical chemical, organoleptic and agronomic evaluation for release as a new *Aspergillus flavus*-resistant cultivar. If A 7109 or any of the potentially *A. flavus* resistant lines prove to be acceptable, they would minimize the potential damage from aflatoxin contamination immediately prior to harvest and in short term curing and storage. Aflatoxin contamination of edible peanuts is of great concern since aflatoxin is a highly carcinogenic natural agent produced on peanuts and other food crops by *Aspergillus* spp under certain environmental conditions.

Germplasm resistant to early leaf spot released - Tifton, Georgia. The leaf-spot resistant 'PI 109839' peanut was released as germplasm. This genotype will be useful in developing resistant cultivars which would lower production costs and energy use and improve quality.

Early maturing, large-seeded Spanish type peanut developed - Stillwater, Oklahoma. Pronto is an early maturing, large-seeded Spanish type peanut with good shelling characteristics and good production potential especially in short growing seasons. It was derived from a cross between two Spanish cultivars, Chico and Comet.

Cylindrocladium black rot resistant germplasm released - Suffolk, Virginia. Screening germplasm resulted in the release of a breeding line, VGP 1, resistant to Cylindrocladium black rot (CBR). Use of this germplasm in breeding program should result in the release of resistant commercial varieties. CBR is a major disease of peanuts for which no control measures are available.

#### Sunflower:

Resistance to charcoal rot disease of sunflower identified - Davis, California. Incidence of charcoal rot among 30 entries in the 1979 National Sunflower Performance Trial at Davis ranged from 60 to 95 percent. Incidence of charcoal rot among selections from a germplasm pool ranged from 0 to 19 percent. Incidence of charcoal rot among 810 entries of the confectionary germplasm collection ranged from 0 to 100 percent.

F<sub>1</sub> hybrid between wild species highly resistant to sclerotinia stalk rot and cultivated sunflower obtained - Beltsville, Maryland. The F<sub>1</sub> hybrid of Helianthus annuus X H. tuberosus was as highly resistant to sclerotinia stalk rot as the wild species, H. tuberosus. The F<sub>1</sub> hybrid was successfully backcrossed to H. annuus.

Cause of apical chlorosis in sunflower identified - Fargo, North Dakota. A bacterium, Pseudomonas tagetis, was identified as the causal organism of apical chlorosis of sunflower. This is the first report of the bacterium attacking sunflower. Incidence of the chlorosis has been low and scattered. Potential severity and etiology of the disease in sunflower are not known.

Seed set problem in F<sub>1</sub> hybrids a complex one - Fargo, North Dakota. Failure of adequate seed set by some F<sub>1</sub> hybrids is a serious problem in sunflowers. Studies to date indicate that in some hybrids, self-incompatibility is inherited as dominant factors from the B-lines, that self-fertility is affected by environment, and that partial fertility restoration may also be a factor in reduced seed set.

Further progress in determining the physiological role of oxygenated fatty acids in plant growth - Fargo, North Dakota. Twelve-Oxo-phytodienoic acid was identified as an endogenous constituent in sunflower seedlings. Experiments with <sup>18</sup>O labeled 13-hydroperoxylinolenic acid showed that the oxo group arises via an epoxide intermediate during the cyclization reaction. Lipxygenase, hydroperoxide isomerase, and hydroperoxide cyclase were found to be very active in cotton seedlings, but the activities of these enzymes were barely detectable in the dry seed.

Multiple disease resistance found in sunflower - Bushland, Texas. Near immunity to Alternaria was observed in crosses between parental lines and H. argophyllus. This finding permits the study of inheritance of resistance to Alternaria. The development of inoculation techniques permits mass screening of sunflower lines for resistance to Rhizopus in the greenhouse. Differences among wild Helianthus species for resistance to Rhizopus pathogens indicate the possibility of breeding sunflower for resistance to Rhizopus head rot. The occurrence of charcoal rot and rust in sunflower in Texas reemphasizes the importance for breeding sunflower for resistance to these two diseases.

Flax:

Number of bolls is major yield component of high yielding flax - Brookings, South Dakota. High yielding Linott flax has been compared with low yielding Grant for a large number of physiological and morphological characters. Number of bolls per area was the major yield component identified: Linott produces 60 percent more flowers per day during a two week blooming period than does Grant.

Safflower:

Resistance to diseases of safflower obtained in interspecific cross - Davis, California. The wild species Carthamus tinctorius and its F<sub>1</sub> hybrid with disease susceptible c. lanatus were highly resistant to leaf spots caused by Alternaria carthami and Pseudomonas syringea, and to wilt caused by Fusarium oxysporium f. sp. carthami. This hybrid is a potential source of genes for disease resistances.

Guar:

Improved guar germplasm developed - Bushland, Texas. Five guar lines possessing bacterial blight resistance, high test weight, and good yielding ability were developed. Three lines are short-statured and possess a determinate growth habit. The fourth line is a non-weathering, indeterminate selection which retains its bright seed coat color in the pod under adverse weather conditions. The fifth line is indeterminate, possesses high test weight and is highly resistant to bacterial blight. Lines were derived from controlled natural crosses made in 1968 and in 1969.

Technological Objective 2: New and improved cultural and management practices that increase oilseed crop yields, minimize production losses, improve quality attributes, and conserve and use scarce resources efficiently.



## Research Locations:

Davis, California  
Gainesville, Florida  
Urbana, Illinois  
West Lafayette, Indiana  
Ames, Iowa  
Beltsville, Maryland  
Stoneville, Mississippi  
Columbia, Missouri  
Raleigh, North Carolina  
Wooster, Ohio  
Brookings, South Dakota  
Suffolk, Virginia

## Examples of Recent Progress:

### Soybeans:

Soil compaction reduces yield, top growth, leaf area, and root density - Urbana, Illinois. Yields of Will soybeans in soil compaction plots averaged 58 bushels per acre as compared to 67 in noncompacted plots. Effect of soil compaction on disease incidence was not evident, possibly because of deficient soil moisture during early stages of growth. Leaf area indexes were reduced 49 and 8 percent on July 10 and 30, respectively, on compacted plots. Correspondingly, plant top dry matter production was reduced 41 and 26 percent on these dates on compacted plots. Root development into the center of rows was restricted by soil compaction.

Roots contribute about 50 percent of the total reduced nitrogen of seedlings - Urbana, Illinois. Based on optimized root nitrate reductase assays and on xylem exudate analyses, roots were shown to contribute about 50 percent of the total reduced nitrogen of soybean seedlings. This is in contrast to previous estimates of root contribution to reduced nitrogen of about 10 percent.

$\beta$  - amylase activity not consistent with its role in starch degradation - Urbana, Illinois. Immature soybean seeds accumulate starch as a transient reserve material which is utilized later in development. The distribution of  $\beta$  - amylase activity is not consistent with its support role in starch degradation.  $\alpha$  - amylase and  $\alpha$  - glucosidase activities could be responsible for starch mobilization.

Organic acid metabolism linked to glycolysis - Urbana, Illinois. Developing soybean seeds contain higher levels of phosphoenolpyruvate carboxylase and malate dehydrogenase, which together yields malate, than of pyruvate kinase, which produces pyruvate. Possibly malate is the major



end product of glycolysis in developing soybean seeds. Malate can be converted into pyruvate and subsequently back into phosphoenolpyruvate constituting a  $\beta$  - carboxylation cycle similar to that operating in  $C_4$  type plants. This cyclic mechanism does not lead to net carbon fixation but rather links organic acid metabolism and the first stages of glycolysis.

Soybean root nodules contain multiple Rhizobium strains - Beltsville, Maryland. The non-nodulating soybean Clark rj1 was inoculated with a mixture of a partially compatible and an incompatible strain of Rhizobium. Drug resistance markers permitted identification of Rhizobium strains in recovered nodules. Analysis of nodules formed showed 32 percent of the nodules contained both strains. Nodulation by the otherwise incompatible strain was facilitated by association with the partially compatible strain.

Nitrogen nutrition level interacts with row width - Wooster, Ohio. On soil not previously cropped to soybeans and lacking soybean rhizobium, non-inoculated soybeans produced higher yields in 30-inch rows than in 7-inch rows. Inoculated soybeans on the same soil produced higher yields in 7-inch rows than in 30-inch rows. Also, the non-nodulated isolate of Clark showed a yield advantage in 7-inch rows as compared to 30-inch rows only when nitrogen fertilizer was applied. These results indicate that nitrogen level, as well as moisture stress, can interact with row width: the yield advantage of soybeans in narrow rows can be achieved only under optimum environmental conditions.

Peanuts:

Forecasting of Cercospora leafspot of peanut by agro-environmental monitoring - Suffolk, Virginia. Two environmental parameters, temperature and relative humidity, can be used to predict when infection of peanuts by the Cercospora leafspot fungi will occur and the disease can be controlled effectively by treatment based on disease predictions. Yields in plots sprayed on a 14 day schedule and sprayed according to the model were similar to each other and both were significantly greater at most locations than the yields in the non-treated controls. The use of this environmental model to predict when fungicide applications are necessary will result in monetary savings to the grower, cause less soil compaction, and most importantly, reduce chemical pesticide use.

Captafol enhances the severity of a nontarget disease pathogen, Sclerotinia minor - Suffolk, Virginia. Captafol, a fungicide used for Cercospora leafspot control in Virginia, enhanced the severity of Sclerotinia blight, a destructive peanut disease caused by the soilborne fungus S. minor. During the growing season the disease index of captafol-treated plants was significantly greater than in the untreated control plants. By the end of the growing season the number of plants killed by S. minor was significantly greater than that observed in the untreated control plants. Also, pod yields per acre were lower in treated plots than in control plots. Growers having histories of Sclerotinia blight should refrain from the use of captafol in their leafspot spray programs.

Development of use of an elutriator in recovering sclerotia of Sclerotinia blight pathogen from infested peanut fields - Suffolk, Virginia. A method of recovery of sclerotia of Sclerotinia minor from soil by elutriation has been devised. Field soil to be assayed is collected, allowed to air dry; subsamples (100 g) are drawn, elutriated (air + water) for 6 min., screened over 40 mesh sieve and sclerotia counts determined by use of stereo-microscope (10X). Recovery rate of sclerotia-seeded soil increased with time of elutriation with most efficient recovery being 20 min. However, a recovery efficiency of over 90% occurs with an elutriation time of 6 min. Sclerotia are more numerous following harvest with counts sometimes averaging 30/100g soil. Sclerotia are usually more numerous in the top 2 inches of soil but can be found at depths of 8 inches.

Controlling Sclerotinia blight in peanuts - Suffolk, Virginia. Under laboratory conditions mycelium and sclerotia of Sclerotinia minor are easily colonized by isolates of Trichoderma viride, Sporidesmium sclerotivorum and Coniothyrium minitans. However, these mycoparasitic fungi did not reduce the severity of Sclerotinia blight under field conditions nor did they reduce the number of sclerotia in the soil. Procymidone provides almost complete control of Sclerotinia minor under severe disease conditions in the field. However, strains of S. minor tolerant to 10 ppm procymidone develop quite frequently on culture media amended with this fungicide. A few strains were tolerant at 100 ppm. Procymidone-tolerant strains of S. minor were also usually tolerant to Botran at the same concentrations. Several fungicides were screened alone or in combination for efficacy in S. minor control. Procymidone was the only fungicide that provided full control of this soil-borne pathogen.

Flax:

Oil content increased by plant growth regulator - Brookings, South Dakota. Chlorflurenol, belonging to a class of plant growth regulators called morphactins, has consistently increased the oil content of flaxseed when applied to the growing plant. The oil content of seed of nontreated plants was 40 percent; the maximum oil content of seed of treated plants was 45 percent

## PUBLICATIONS

### Soybeans:

#### Davis, California

Carlson, E. C., B. H. Beard, R. Tarailo, and R. L. Witt. 1979. Testing soybeans for resistance to spidermites. Calif. Agr. 33(9):9-11.

#### Gainesville, Florida

Hinson, K., E. E. Hartwig, and A. Scott. 1979. Registration of Alamo soybeans. Crop Sci. 19:748.

#### Urbana, Illinois

Kittle, D. R. and L. E. Gray. 1979. Production and pathogenicity of oospores of Phytophthora megasperma var. sojae. Plant Dis. Reptr. 63(8) 628-631.

Kittle, D. R. and L. E. Gray. 1979. Storage and use of Phytophthora megasperma var. sojae oospores inoculum. Phytopathology 69:821-823.

Kohl, D. H., G. Shearer, and J. E. Harper. 1979. Natural abundance of  $^{15}\text{N}$  in nodulating and nonnodulating isolines of soybeans. In Stable Isotopes: Proceedings of 3rd International Conference. Academic Press, New York, pp. 317-325.

Pataky, J. K., S. M. Lim, E. G. Jordan, and R. L. Warsaw. 1979. Monitoring soybeans for foliar diseases. Illinois Research 21(3): 3-4

Schweitzer, L. E. and J. E. Harper. 1980. Effect of light, dark, and temperature on root nodule activity (acetylene reduction) of soybeans. Plant Physiol. 65:51-56.

#### West Lafayette, Indiana

Abney, T. S., Laviolette, F. A., and Wilcox, J. R. 1979. Indiana soybean disease and crop condition survey 1979. Purdue Univ. Agr. Expt. Sta. Bull. No. 246.

Athow, K. L., Laviolette, F. A., and Wilcox, J. R. 1979. Genetics of resistance to physiologic races of Phytophthora megasperma var. sojae in the soybean cultivar Tracy. Phytopathology 69:641-642.

Laviolette, F. A., Athow, K. L., Mueller, E. H. and Wilcox, J. R. 1979. Inheritance of resistance in soybeans to physiologic races 5, 6, 7, 8, and 9 of Phytophthora megasperma var. sojae. Phytopathology 69:270-271.

Moreira, M. A., Hermodson, M. A., Larkins, B. A., and Nielsen, N. C. 1979. Partial characterization of the acidic and basic polypeptides of glycinin. *J. Biol. Chem.* 254:9921-9926.

Nielsen, N. C., Adie, A., and Stumpf, P. K. 1979. Fat metabolism in higher plants: Further characterization of wheat germ acetyl Co A carboxylase. *Arch. Biochem. Biophys.* 192:446-456.

Nielsen, N. C., Smilie, R. M., Henningsen, K. W., von Wettstein, D., and French, S. 1979. Composition and function of thylakoid membranes from grana-rich and grana-deficient mutants of barley. *Plant Physiol.* 63:174-182.

Wilcox, J. R., Athow, K. L., Laviolette, F. A., Abney, T. S., and Richards, T. C. 1979. Cumberland and Oakland soybeans in Indiana. *Purdue Univ. Agr. Expt. Sta. Bull.* 225.

Wilcox, J. R., Athow, K. L., Laviolette, F. A., Abney, T. X., and Richards, T. L. 1979. Vickery soybean in Indiana. *Purdue Univ. Agr. Expt. Sta. Bull.* 224.

Wilcox, J. R., Athow, K. L., Laviolette, F. A., Abney, T. S., and Richards, T. L. 1979. Registration of Wells II soybean (Reg. No. 122). *Crop Sci.* 19:296.

Wilcox, J. R., Schapaugh, W. T., Jr., Bernard, R. L., Cooper, R. L., Fehr, W. R., and Niehaus, M. H. 1979. Genetic improvement in soybeans in the Midwest. *Crop Sci.* 19:803-805.

#### Ames, Iowa

Albertsen, M. C. and R. G. Palmer. 1979. A comparative light- and electron-microscope study of microsporogenesis in male sterile (ms<sub>1</sub>) and male fertile soybean (*Glycine max* (L.) Merr.). *Amer. J. Bot.* 66: 253-265.

Palmer, R. G. and R. C. Payne. 1979. Genetic control of hypocotyl pigmentation among white-flowered soybeans grown in continuous light. *Crop Sci.* 19:124-126.

Tachibana, H. and G. D. Booth. 1979. An efficient and objective survey method for brown stem rot of soybeans. *Plant Dis. Rep.* 63:539-541.

Tachibana, H. and L. C. Card. 1979. Field evaluation of soybeans resistant to brown stem rot. *Plant Dis. Rep.* 63:1042-1045.

#### Beltsville, Maryland

Devine, T. E., L. D. Kuykendall, and B. H. Breithaupt. 1980. Nodulation of soybeans carrying the nodulation restrictive gene, rj1, by an incompatible Rhizobium japonicum strain upon mixed inoculation with a compatible strain. *Can. J. microbiol.* 26:179-182.



Keyser, H. H. and D. N. Munns. 1979. Tolerance of rhizobia to acidity, aluminum and phosphate. Soil Sci. Soc. Am. J. 43:519-523.

Keyser, H. H. and D. N. Munns. 1979. Effects of calcium, manganese and aluminum on growth of rhizobia in acid media. Soil Sci. Soc. Am. J. 43:500-503.

Kuykendall, L. D. 1979. Transfer of R factors to and between genetically marked sublines of Rhizobium japonicum. Applied and Environmental Microbiology 37:862-866.

Munns, D. N., H. H. Keyser, V. W. Fogle, J. S. Hohenberg, T. L. Righertii, D. L. Lauter, M. G. Zarong, K. L. Clarkin and K. W. Whiteacre. 1979. Tolerance of soil acidity in symbioses of mung bean with rhizobia. Agron. J. 71:256-260.

#### Stoneville, Mississippi

Hartwig, E. E., and Kihl, R. A. S. 1979. Identification and utilization of a delayed flowering character in soybeans for short-day conditions. Field Crops 2:145-151.

Hatchett, J. H., Beland, G. L., and Kilen, T. C. 1979. Identification of multiple insect resistance soybean lines. Crop Sci. 19:557-559.

Heatherly, Larry G. and W. J. Russell. 1979. Effect of soil water potential of two soils on soybean emergence. Agron. J. 71:980-982.

Heatherly, Larry G., and W. J. Russell. 1979. Vegetative development of soybeans grown on different soil types. Field Crops Res. 2:135-143.

Kihl, R. A. S. and Hartwig, E. E. 1979. Inheritance of reaction to soybean mosaic virus in soybeans. Crop Sci. 19:372-375.

Kilen, T. C. 1979. A temperature sensitive miniature soybean. Crop Sci. 19:405-406.

Kilen, T. C. 1979. Selection for resistance to four races of Phytophthora megasperma var. sojae in soybean. Crop Sci. 19:581-582.

Petri, H. N., V. C. Patel, and B. L. Keeling. 1979. Distribution of bean pod mottle disease on soybeans in Mississippi. Plant Disease Reporter 63:419-423.

#### Columbia, Missouri

Luedders, V. D. 1978. Effect of Maturity on Competitive Ability in Soybeans. Euphytica 28:509-513.

Luedders, V. D., and J. S. Burris. 1979. Effects of Broken Seed Coats on Field Emergence of Soybeans. Agronomy Journal 71:877-879.

Luedders, V. D., O. E. Carling, and M. F. Brown. 1979. Effect of Soybean Plant Growth on Spore Production by Glomus mosseae. Plant and Soil 53:393-397.

Luedders, V. D., J. G. Shannon, and C. H. Baldwin, Jr. 1979. Influence of Rate and Source of Potassium on Soybean Cyst Nematode Reproduction on Soybean Seedlings. Plant Disease Reporter 63:558-560.

Marston, N. L., G. D. Thomas, C. M. Ignoffo, M. R. Gebhardt, D. L. Hostetter, and W. A. Dickerson. 1979. Seasonal Cycles of Soybean Arthropods in Missouri: Effect of Pesticidal and Cultural Practices. Environ. Entomology 8:165-173.

Short, G. E., T. D. Wyllie, and P. R. Bristow. 1980. Survival of Macrophomina phaseolina in Soil and in Residue of Soybean. Ecology and Epidemiology 70:13-17.

#### Raleigh, North Carolina

Brim, C. A., and J. W. Burton. 1979. Recurrent selection in soybeans. II. Selection for increased percent protein in seeds. Crop Sci. 19:494-498.

Burton, J. W., R. F. Wilson, and C. A. Brim. 1979. Dry matter and nitrogen accumulation in male-sterile and male-fertile soybeans. Agron. Journal 71:548-552.

Smith, C. M. and C. A. Brim. 1979. Resistance to Mexican bean beetle and corn earworm in soybean genotypes derived from PI227687. Crop Sci. 19:313-314.

Smith, C. M., R. F. Wilson, and C. A. Brim. 1979. Feeding behavior of Mexican bean beetle on leaf extracts of resistant and susceptible soybean genotypes. J. Econ. Entomology 72:374-377.

Young, L. D., and J. P. Ross. 1979. Brown spot development and yield response of soybean inoculated with Septoria glycines at various growth stages. Phytopathology 69:8-11.

#### Peanuts:

#### Tifton, Georgia

Branch, W. D. and Ray O. Hammons. 1979. Inheritance of testa color variegation in Peanut. Crop Sci. 19:786-789.

Hammons, Ray O. and A. J. Norden. 1979. Registration of Jenkins Jumbo peanut (reg. PL-1). Crop Sci. 19:132.

Sanders, T. H., and A. C. Mixon. 1979. Effect of peanut tannins on peanut seed colonization and in vitro growth by Aspergillus parasiticus. Mycopathologia 66:169-174.

Stillwater, Oklahoma

Eskins, K. and Banks, D. J. 1979. The relationship of accessory pigments to chlorophyll a content in chlorophyll-deficient peanut and soybean varieties. Photo-chem. and Photobiol. 30:585-588.

Ketring, D. L. 1979. Light effects on development of an indeterminate plant. Plant Physiol. 64:665-667.

Ketring, D. L. 1979. Physiology of peanut seeds that received subfreezing temperatures while in the window. Peanut Sci. 6:80-83.

Suffolk, Virginia

Coffelt, T. A., F. S. Wright and J. L. Steele. 1979. New harvesting and curing techniques in the production of breeder's seed peanuts. Peanut Science 6:70-72.

Sunflower:

Davis, California

Klisiewicz, J. M. 1979. Relation of infestation with sunflower moth Homoeosoma electellum larvae to the incidence of Rhizopus rot in sunflower seed heads. Can. J. Plant Sci. 59:797-801.

Fargo, North Dakota

Fick, G. N., D. E. Zimmer and D. C. Zimmerman. 1979. Registration of nine sunflower parental lines (Reg. No. PL 17 to PL 25). Crop Sci. 19:423.

Miller, J. F. 1979. Wild sunflower: Interest is worldwide. Sunflower 5:20.

Zimmerman, D. C. and C. A. Coudron. 1979. Identification of traumatin, a wound hormone, as 12-oxo-trans-10-dodecenoic acid. Plant Physiol. 63:536-541.

Bushland, Texas

Rogers, C. E. Thompson, T. E., and Gagne, R. J. 1979. Cecidomyiidae of Helianthus: Taxonomy, hosts, and distribution. Ann. Entomol. Soc. Am. 72:109-113.

Rogers, C. E., and Thompson, T. E. 1979. Helianthus resistance to Masonaphis masoni. Southwest. Entomol. 4:321-324.

Rogers, C. E., Thompson, T. E., Jones, O. R. 1979. Eucosma womonana Kearfott (Lepidoptera: Oleth-reutidae): A new pest of sunflower in the Southern Plains. J. Kans. Entomol. Soc. 52:373-376.

Thompson, T. E., Fick, G. N., and Cedeno, J. R. 1979. Maternal control of seed oil percentage in sunflower. Crop Sci. 19:617-619.

Yang, S. M., Morris, J. B., Unger, P. W., and Thompson, T. E. 1979. Rhizopus head rot of cultivated sunflower in Texas. Pl. Dis. Reprtr. 63:833-835.

Flax:

Fargo, North Dakota

Feng, P. and D. C. Zimmerman. 1979. Substrate specificity of flax hydroperoxide isomerase. Lipids 14:710-713.

Miller, J. R., and J. J. Hammond. 1979. Cooperative flax trials in the spring flax region - 1978. ARM-NC-5. 14pp.

Vick, B. A., D. C. Zimmerman and D. Weisleder. 1979. Thermal alteration of a cyclic fatty acid produced by a flaxseed extract. Lipids 14:734-740.

Vick, B. A., and D. C. Zimmerman. 1979. Distribution of a fatty acid cyclase enzyme system in plants. Plant Physiol. 64:203-205.

Vick, B. A., and D. C. Zimmerman. 1979. Substrate specificity for the synthesis of cyclic fatty acids by a flaxseed extract. Plant Physiol. 63:490-494.

Safflower:

Davis, California

Urie, A. L., D. J. Da Via, P. F. Knowles, and L. H. Zimmerman. 1980. Registration of 14-5 safflower germplasm. Crop Sci. 20:115-116.

Urie, A. L., W. F. Peterson, and P. F. Knowles. 1979. Registration of Oleic Leed safflower. Crop Sci. 19:747.



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## National Research Program 20090

### BREEDING AND PRODUCTION - SUGAR CROPS

This National Research Program involves research in breeding and production of sugarcane, sugarbeets, and sweet sorghum. New varieties, hybrids, and breeding lines are developed to improve yield, pest resistance, and drought, cold, and salt tolerance. Cultural and management practices are developed that will improve sugar and sirup yields and reduce production costs. Plant pathologists, geneticists, physiologists, and agronomists work as teams within commodities, sometimes with State researchers, to accomplish the mission.

Technological Objective 1: Develop new and improved breeding lines and varieties that combine high yielding potential and favored quality characters with better pest resistance, drought-cold-salt tolerance, and adaptation to mechanized culture, harvesting, handling, and storage.

NPS Contact: Norman I. James

#### Research Locations:

Salinas, California  
Fort Collins, Colorado  
Canal Point, Florida  
Aiea, Hawaii  
Houma, Louisiana

Beltsville, Maryland  
East Lansing, Michigan  
Meridian, Mississippi  
Fargo, North Dakota  
Logan, Utah

#### Examples of Recent Progress:

##### Sugarbeet:

##### Sources of nematode resistance for sugarbeets identified - Salinas, CA.

Among some 40 nematode-resistant families investigated, one family contained all 67 progeny plants with the resistance. This indicates that about 2.5% of the selfed or cross-pollinated resistant heterozygous sugarbeets of this source yielded bred-true, possibly homozygous, nematode resistant progeny. Sugarbeet germplasm lines homozygous in nematode resistance can be established in future generations. Out-crossing the resistant homozygotes will facilitate the understanding of resistance transmission.

##### Improvement of self-fertile, monogerm sugarbeet populations - Salinas, CA.

Self-fertile, genetic male-sterile facilitated random-mating populations were further improved by additional cycles of selection for disease resistance, sugar yield, and type-0. The levels of disease resistance and yield performance of these populations are nearly equal to adapted, multigerm, self-sterile

lines. The performance of experimental population crosses produced on nearly equivalent genetic or cytoplasmic male-sterile phases has shown that the mean general combining ability of these populations is about equal and in some cases superior to commercially used monogerm parental lines. As desired, these populations appear to be well suited for recurrent selection for intra- and inter-population improvement and as sources for extracting improved inbred lines. In a test of intra-population improvement based on  $S_1$  and testcross selection,  $S_1$  progenies had greater efficacy for discriminating  $S_0$  genotypes than did testcross progenies.  $S_1$  progenies for the second cycle of recurrent selection were produced.

First rhizoctonia resistant monogerm sugarbeet with male sterility - Fort Collins, CO. A rhizoctonia resistant monogerm cytoplasmic male sterile sugarbeet and its type 0 (maintainer) have been developed and released. The development is significant because it makes available for the first time a rhizoctonia resistant monogerm male sterile sugarbeet for use as a female in the production of hybrid varieties resistant to this ubiquitous root rot disease. The germplasm also may serve as a source for genetic transfer of resistance directly into currently used susceptible male sterile parents of hybrid varieties.

The development and release of FC 607 - Fort Collins, CO. FC 607 and its cytoplasmic male sterile equivalent, FC 607 CMS, are high vigor monogerm sugarbeet breeding lines which have levels of combined resistance to Cercospora and the curly top virus never previously attained. In addition to good vigor and high disease resistance to two serious diseases, the lines are good seed producers and have good combining ability for sucrose. These germplasm developments were officially released to commercial plant breeders in June 1979.

"Soil-free" sugarbeet roots selected - Beltsville, MD. The latest soil-free backcross lines appear to have increased in sucrose percentage enough to be usable commercially or as breeding material in producing parental material of commercial varieties. Soil-free taproots could reduce the weight and complexity of harvesters and have the potential of reducing losses in storage piles by millions of dollars annually.

New system increases capacity for sugarbeet clonal propagation and germplasm storage, East Lansing, MI. Improvement of a system to multiply beet plants using tissue culture was achieved, enabling breeders to preserve and rapidly multiply superior genotypes with minimal space and labor requirements. Small shoots from superior sugarbeets are removed and placed onto tissue culture medium where a hormone stimulates rapid multiplication of shoots. Shoots are rooted in peat before potting in soil. Shoot-derived plants from many beets can be induced to flower in less than two months using continuous incandescent light, compared with the three months or more necessary using the usual cold treatment.

Identification of physiological reasons for negative correlation between root yield and sugar percentage in sugarbeet - Logan, UT. Increases in root yield are generally accompanied by corresponding decreases in sucrose percentage which make increases in total sucrose difficult to achieve. Cell size has been found to have the opposite effects on root yield and sucrose percentage,



i.e., large-celled genotypes have large roots and are low in sucrose concentration, whereas small-celled genotypes have small roots and are high in sucrose concentration. This relationship is the physiological principle responsible for the negative correlation between root yield and sucrose concentration. This important breakthrough points out the need to critically evaluate breeding methods which affect cell size.

Identification of the cellular parameters responsible for hybrid vigor in sugarbeet root yield and sugar percentage - Logan, UT. Increases in sugarbeet root yield are due to increases in cell size and cell division rate. Genetic studies revealed that hybrid vigor is the result of an increased cell division rate and not to increased cell size. Since hybrid vigor is a common phenomenon in the plant kingdoms, we believe these results can be extended to other crops.

#### Sugarcane:

New smut resistant sugarcane variety released - Canal Point, FL. A new smut resistant sugarcane variety, CP 69-1052, was released for production in the Florida sugar industry. CP 69-1052 produced sugar/acre yields equal to those of the most widely grown cultivar, CP 63-588, and was resistant to smut in Florida, Jamaica, and Hawaii.

Sugar content of sugarcane varieties dramatically increased - Houma, LA. A variety improvement program, encompassing a 55-year period, has resulted in a steady increase in the sugar contained in sugarcane. The average sugar content of test varieties has risen from 7% to 13%; of the 111 varieties in 1979 tests, none were as low in sugar as the best of the 10 varieties available in 1930. This increase in sugar content has been largely responsible for the increased sugar recoveries by Louisiana's mills. The State's aging mills averaged 6.8% sugar per ton in the 1920's and averaged 10% for the last two years. This increase took place in spite of harvest mechanization, a phenomena which caused declines in sugar recovery during the same period in Puerto Rico and Hawaii.

#### Sweet Sorghum:

Mutagenic effect of sugarcane mosaic virus in sweet sorghum - Beltsville, MD. Progenies from crosses of sweet sorghum in which one parent was infected with sugarcane mosaic virus were compared with progenies from crosses in which both parents were healthy. Significant increases in deviation of dihybrid populations from the expected Mendelian ratios were observed. These observations demonstrate the lasting effect that viral infections can have on crops and have implications in explaining gradual declines in crop yield.

World Sweet Sorghum Collection improved - Meridian, MS. The World Sweet Sorghum Collection has been significantly improved over the past year through seed increase, recovery of viable seed from old seed, and collection of needed descriptor data. The availability of seed and descriptor data will greatly enhance the efforts of sorghum breeders throughout the world in their search for a germplasm source to develop new and improved varieties of sorghum for



sirup, sugar, forage, grain, and biomass production, the latter of which having reached a high level of importance in view of our world-wide shortage of fossil fuels.

Technological Objective 2: Develop new and improved cultural and management practices to increase sugar and sirup yields, minimize production losses, improve quality attributes, and efficiently conserve scarce resources.

#### Research Locations:

Salinas, California  
Fort Collins, Colorado  
Canal Point, Florida  
Aiea, Hawaii  
Houma, Louisiana

Beltsville, Maryland  
East Lansing, Michigan  
Meridian, Mississippi  
Fargo, North Dakota  
Logan, Utah

#### Examples of Recent Progress:

##### Sugarbeet:

New relationships discovered among yellowing viruses - Salinas, CA. Studies have been under way for several years to determine the relationships of beet western yellows virus (BWYV) to yellowing viruses of legumes, solanaceous plants, and other crop and weed hosts. The recent discovery of an apparently new luteovirus affecting only solanaceous hosts (Solanum yellows virus) supports the possibility that potato leafroll virus (PLRV) may be caused by a complex of yellowing agents, some of which are luteoviruses. Recent evidence indicates that although BWYV antiserum does not react with PLRV, antiserum to PLRV reacts positively with BWYV. A complex etiology of potato leafroll virus would help to explain some of the confusion that has been characteristic of this disease since its discovery in the 1700's.

Systemic insecticide increased rhizoctonia root rot - Fort Collins, CO. In some areas where curly top virus causes appreciable losses in sugarbeet, phorate commonly is used to control the leafhopper vector. Our field study showed that phorate significantly increased root rot severity incited by Rhizoctonia solani. Although differences were not significant, carbofuran and aldicarb also tended to increase rot.

Techniques developed to reliably evaluate field research on rhizoctonia root and crown rot of sugarbeets - East Lansing, MI. Uniform epiphytotics of sugarbeet root rot induced by Rhizoctonia solani were initiated at Fort Collins, Colorado, and East Lansing, Michigan, with mechanical applications of dry ground barley-grain inoculum in the center of the row with a modified granule applicator. Equipment, inoculum preparation, field rates, and disease evaluations, while basically similar, differ in details at the two locations. These methods were effective and reliable for use in evaluations of

sugarbeet cultivars for resistance to the fungus and have replaced tedious and time-consuming methods previously used. EL42, a Rhizoctonia-resistant multigerm variety was developed with the assistance of this technique. This technique is important since it enabled the research to expand from evaluation of a few roots to the evaluation of thousands per year at little, if any, additional expense.

Reducing sugarbeet storage rot with thiabendazole or genetic resistance - Fargo, ND. Thiabendazole treatment of roots reduced storage rot to a trace amount in susceptible hybrids after storage for 100 days. Rot in genetically resistant breeding lines was nearly as low. A sugar factory could have saved about 2.8 million pounds of sucrose from 280,000 tons of roots if they had been protected from rot with thiabendazole or been genetically resistant to the rot-causing fungi.

Long-term effect of fungicidal seed treatment for Phoma betae - Fargo, ND. Fungicidal seed treatment of seed heavily infected with P. betae did not improve stand counts but did reduce infection of seedlings. The best fungicides were thiram, thiram-seed soak, and imidazole. Reduced seedling infection gave only partial and unacceptable reduction in storage rot. Each 1% increase in infected seedlings caused a 0.04% increase in storage rot. Each 1% increase in storage rot caused a loss of 6 lbs of sucrose per ton of roots during 150 days of storage.

#### Sugarcane:

Use of GA<sub>3</sub> proven to increase sugarcane yields, is adopted by the Hawaiian industry - Aiea, HI. Yields of paired plots showed a gain of 1.4 tons of sugar per hectare attributable to GA<sub>3</sub> treatment. Approximately 4,000 hectares of sugarcane in Hawaii received GA<sub>3</sub> this past winter. These treatments should bring a profit of \$2 million to the industry.

#### Sweet Sorghum:

Inhibitory activity of microbial polysaccharides of sugarcane mosaic virus of sweet sorghum - Beltsville, MD. Polysaccharides from yeast cell walls and from Bacillus subtilis and Streptococcus pneumoniae Type III cell-free culture liquids inhibited SCMV infection of sorghum by 90-100%. These observations present the possibility that environmentally safe natural products such as these can be used for the control of plant diseases.

# VARIETIES RELEASED

<u>Name or Designation</u>	<u>Release Agencies</u>	<u>Reason for Release</u>
Sugarcane CP 69-1052	SEA/AR, Florida AES, Florida Sugar Cane League	Good stubbling, high ton- nage, late flowering
Sweet Sorghum Keller	SEA/AR, Louisiana, Mississippi, and Texas AES	High sucrose
Sugarbeet US H11	SEA/AR, Beet Sugar Development Found., and California Beet Growers Assn.	Soft rot and other multi- ple disease resistance

## NONCOMMERCIAL GERMPLASM RELEASED

### Sugarbeet

FC 607	SEA/AR, Colorado AES, and BSDF	Leaf spot and curly top resistance
FC 607 CMS	SEA/AR, Colorado AES, and BSDF	Leaf spot and curly top resistance
EL 46	SEA/AR & Michigan AES	Multigerm breeding line
SP 78564-01	SEA/AR, Michigan AES, and BSDF	CMS monogerm moderately resistant to black spot and highly resistant to leaf spot
SP 78564-0	SEA/AR, Michigan AES, and BSDF	O-type monogerm maintainer line of SP 78564-01

## P U B L I C A T I O N S

### Sugarbeet:

#### Salinas, California

Duffus, James E. 1979. The ecology of yellowing viruses--Epidemiology and control of virus diseases of vegetables. Proc. 3rd Conf. of ISHS Working Group on Vegetable Viruses. 37-40.

Hoefert, L. L. 1979. Ultrastructure of developing sieve elements in Thlaspi arvense L. I. The immature state. Amer. J. Bot. 66:925-932.

Hoefert, L. L. 1980. Ultrastructure of developing sieve elements in Thlaspi arvense L. II. Maturation. Amer. J. Bot. 67:194-201.

Schroth, M. N., E. D. Whitney, S. V. Thomson, R. T. Lewellen, and F. J. Hills. 1979. Bacterial rot of sugarbeet: problem and solution. California Agriculture 33:8-9.

Yu, M. H. 1979. Transmission of nematode resistance and meiosis in sugarbeets of different ploidy. Genetics 91:142.

#### Fort Collins, Colorado

Hecker, R. J. and E. G. Ruppel. 1979. Registration of FC 702/4, FC 702/4 (4X), FC 705, FC 706, and FC 707 sugarbeet germplasm (Reg. Nos. GP 55-GP 59). Crop Sci. 19:935.

Hecker, R. J. and G. A. Smith. 1979. Registration of FC 704 sugarbeet germplasm (Reg. No. GP 54). Crop Sci. 19:934.

Ruppel, E. G., C. L. Schneider, R. J. Hecker, and G. J. Hogaboam. 1979. Creating epiphytotics of rhizoctonia root rot and evaluating for resistance to Rhizoctonia solani in sugarbeet field plots. Plant Dis. Reptr. 63:518-522.

Ruppel, E. G., A. D. Jenkins, and L. M. Burtch. 1979. Persistence of benomyl-tolerant strains of Cercospora beticola in the absence of benomyl. Phytopathology 70:25-26.

Smith, G. A. and J. O. Gaskill. 1979. Registration of FC 902 sugarbeet germplasm (Reg. No. GP 41). Crop Sci. 19:131.

Smith, G. A. and J. O. Gaskill. 1979. Registration of six sugarbeet germplasm lines (Reg. No. GP 42 - GP 47). Crop Sci. 19:131.

Smith, G. A., R. J. Hecker, and S. S. Martin. 1979. Effects of ploidy level on the components of sucrose yield and quality in sugarbeet. Crop Sci. 19:319-323.

Smith, G. A. and E. G. Ruppel. 1979. Registration of four sugarbeet germplasm lines (Reg. No. GP 48 - GP 51). Crop Sci. 19:131-132.



Smith, G. A. and E. G. Ruppel. 1979. Registration of FC 606 and FC 606 CMS sugarbeet germplasm (Reg. Nos. GP 52 and GP 53). Crop Sci. 19:300.

Steinkamp, M. P., S. S. Martin, L. L. Hoefert, and E. G. Ruppel. 1979. Ultrastructure of lesions produced by Cercospora beticola in leaves of Beta vulgaris. Physiol. Plant Pathol. 15:13-26.

#### Beltsville, Maryland

Coe, G. E. 1979. Status of breeding sugarbeets for resistance to *Cercospora* leaf spot disease, soil-free taproots, and increased root size. Proc. 20th Regional Meeting, Amer. Soc. Sugar Beet Technol., Eastern U.S. pp 74-78.

#### East Lansing, Michigan

Hogaboam, G. J. and C. L. Schneider. 1979. Efforts to control *Rhizoctonia* rot of sugarbeets through resistance breeding and fungicide application. Proc. 20th Regional Meeting, Amer. Soc. Sugar Beet Technol. pp 81-89.

Ruppel, E. G., C. L. Schneider, R. J. Hecker, and G. J. Hogaboam. 1979. Creating epiphytotics of *Rhizoctonia* root rot and evaluating for resistance to *Rhizoctonia solani* in sugarbeet field plots. Plant Dis. Repr. 34:394-396.

#### Fargo, North Dakota

Bugbee, W. M. 1979. Resistance to sugarbeet storage rot pathogens. Phytopathology 69:1250-1252.

Bugbee, W. M. and D. F. Cole. 1979. Comparison of thiabendazole and genetic resistance for control of sugarbeet storage rot. Phytopathology 69:1230-1232.

#### Logan, Utah

Doney, D. L. 1979. Sugarbeet seedling physiology. J. Am. Soc. Sugar Beet Technol. 20:399-418.

Doney, D. L. (ed.). 1979. Physiological selections in sugarbeet. J. Am. Soc. Sugar Beet Technol. 20:321-433.

Theurer, J. C. 1979. Growth patterns in sugarbeet production. J. Amer. Soc. Sugar Beet Technol. 20: 343-367.

Theurer, J. C. 1979. Effect of DPX3778 as a male gametocide in sugarbeets. Can. J. Plant Sci. 59:463-468.

Thornley, W. R. and D. L. Mumford. 1979. Intracellular location of beet curly top virus antigen as revealed by fluorescent antibody staining. Phytopathology 60:738-740.

Wyse, R. E. 1979. Root parameters controlling sucrose content and root yield in sugarbeet. J. Amer. Soc. Sugar Beet Technol. 20:368-385.

Wyse, R. E. and C. L. Peterson. 1979. Effects of injury on the respiration rate of sugarbeet roots. J. Amer. Soc. Sugar Beet Technol. 20:269-280.

Wyse, R. E. 1979. Sugarbeets: not as tough as they look. Utah Science 40: 42-43.

Wyse, R. E. 1979. Sucrose uptake by sugarbeet tap root tissue. Plant Physiology 64:837-841.

Wyse, R. E. 1979. Effect of harvest injury on respiration and sucrose loss in sugarbeet roots during storage. J. Amer. Soc. Sugar Beet Technol. 20: 193-202.

#### Sugarcane:

##### Canal Point, Florida

Dean, J. L., P. Y. P. Tai, and E. H. Todd. 1979. Sugarcane rust in Florida. Sugar J. 42(2):10.

##### Aiea, Hawaii

Buren, L. L., P. H. Moore and Y. Yamasaki. 1979. Gibberellin studies with sugarcane. II. Hand-sampled field trials. Crop Sci. 19:425-428.

Moore, P. H. and R. V. Osgood. 1979. Small paired plots to evaluate the effect of GA<sub>3</sub> on tons cane per acre and estimated tons sugar per acre. Hawaiian Sugar Planters' Experiment Station Agronomy Report 31. 3 pp.

##### Houma, Louisiana

Dunckelman, P. H., R. D. Breaux, and H. P. Fanguy. 1979. Registration of CP 70-330 sugarcane. Crop Sci. 19:413.

Fanguy, H. P., P. H. Dunckelman, and R. D. Breaux. 1979. Registration of CP 70-321 sugarcane. Crop Sci. 19:413.

Fanguy, H. P. and L. L. McCormick. The Louisiana variety census for 1978. Sugar Bull. 57(13):12-14.

Garrison, D. D., C. A. Richard, W. R. Jackson, and K. P. Bischoff. 1979. Sugarcane outfield experiments in Louisiana during 1977. Sugar Bull. 57(17):10-13.

Irvine, J. E. 1979. Farming for food or fuel. Sugar J. 41(12):15.

Irvine, J. E. 1979. Sugarcane smut and rust and their dispersal in the New World. Sugar J. 42(1):32.

Irvine, J. E. 1979. The wonder of Haft Tappeh. Sugar J. 42(5):24.

Irvine, J. E. 1979. Sugar and nutrition. Sugar J. 42(7):11.

Beltsville, Maryland

Gillaspie, A. G., Jr. and R. W. Harris. 1979. Limitations of ELISA for detection of the RSD-associated bacterium in sugarcane and sudangrass. Sugarcane Pathologists' Newsletter 22:25-28.

Gillaspie, A. G., Jr. and R. G. Mock. 1979. Recent survey of sugarcane mosaic virus strains from Colombia, Egypt, and Japan. Sugarcane Pathologists' Newsletter 22:21-23.

Kahn, R. P., H. E. Waterworth, A. G. Gillaspie, Jr., J. A. Foster, A. C. Goheen, R. L. Monroe, W. L. Povich, R. G. Mock, C. F. Lunh, E. C. Calavan, and C. N. Roistacher. 1979. Detection of viruses or virus-like agents in vegetatively propagated plant importations under quarantine in the United States, 1968-1978. Plant Dis. Reptr. 63:775-779.

Sweet Sorghum:

Meridian, Mississippi

Broadhead, D. M. 1979. Influence of bagging sweet sorghum panicles on stalk yield and juice quality. Crop Sci. 19:195-196.

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## National Research Program 20100

### BREEDING AND PRODUCTION - FORAGE CROPS FOR HAY, PASTURES AND OTHER USES, INCLUDING TURF

This National Research Program outlines a research program on crop production efficiency to develop new knowledge and to increase crop and livestock productivity. Forage crops for hay, pasture, silage, and other uses, including turf; and grass and legume seed production represent a resource of major economic significance in the United States.

NPS Contact: G. E. Carlson

Technological Objective 1: New and improved genetic populations, breeding lines, and cultivars of forage crops with improved yield, special use characteristics, quality, pest resistance, and tolerance to environmental stress.

#### Research Locations:

Palmer, Alaska  
Tifton, Georgia  
Manhattan, Kansas  
Lexington, Kentucky  
Beltsville, Maryland (PGGI)  
Beltsville, Maryland (PPHI)  
St. Paul, Minnesota  
Mississippi State, Mississippi  
Lincoln, Nebraska  
Reno, Nevada  
Oxford, North Carolina  
Raleigh, North Carolina  
Mandan, North Dakota  
Philadelphia, Pennsylvania  
University Park, Pennsylvania  
Clemson, South Carolina  
College Station, Texas  
Temple, Texas  
Prosser, Washington  
Madison, Wisconsin

#### Examples of Recent Progress:

Tifton 44 bermudagrass still tops - Tifton, Georgia. For a belt 500 miles wide from the Atlantic to central Texas, Tifton 44 bermudagrass is more dependable and otherwise superior to Coastal, Alicia, and other warm-season grasses, so report 30 agronomists in 14 States. In the past 2 years, 500 farmers throughout the area have qualified as certified growers and have obtained breeders planting stock of Tifton 44 from SEA-AR. A letter with

suggestions for successful planting was mailed to these growers and pasture extension specialists in all Southern States. Every acre planted to Tifton 44 will cut the cost of producing beef in the South.

Tifblue-78 and Tifwhite-78 released - Tifton, Georgia. Two newly released lupine varieties have the potential for providing grazing, supplying nitrogen, and producing valuable crop of seed. These varieties are seed-shatter resistant which facilitates seed harvesting. Tifblue-78 variety of blue lupine is winterhardy at Tifton and southward. It is resistant to gray leafspot and anthracnose, two serious diseases of lupine. The variety has good forage production and protein content, is free of alkaloid (sweet), and produces good yields of soft seed which will not present problems from reseeding. Seed yields are high and the seed has high protein content and is highly digestible. Tifwhite-78 variety of white lupine is more winterhardy than Tifblue-78 and produces more seed which do not shatter at maturity. Yields of 2,500 to 3,000 pounds per acre of grain that have potential as a high-protein feedstuff for livestock make Tifwhite-78 a promising winter-growing leguminous grain crop.

Breeding methodology research pays off - Tifton, Georgia. Recurrent restricted phenotypic selection (RRPS) is a plant breeding system developed over a number of years that quadruples the efficiency of mass selection in improving Pensacola bahiagrass yields. In its present form, RRPS can increase forage yields in 1 year as much as mass selection could do in 4 years. An experimental variety developed with RRPS yielded 17.7% more in clipped plots and 16% more in a 3-year grazing trial than the Pensacola bahiagrass check. RRPS can be used in breeding other cross-pollinated forages.

Seed set does not significantly affect the forage quality of pearl millet - Tifton, Georgia. Forage quality, as measured by IVDM and total nonstructural carbohydrates, was not significantly different for barren and fruited plants of two pearl millet inbreds. Similar results have been reported for maize and sorghum. These results indicate that it will not be necessary to restore fertility in pearl millet hybrids developed for silage.

Glandular-haired *Medicago* species show promise as a source of resistance to the alfalfa weevil - Manhattan, Kansas. Tetraploid annual *M.* species (*M. scutellata*, *M. rugosa*) were highly resistant to alfalfa weevil larvae over a wide range of temperatures (17° to 28° C). Also, glandular-hair development and secretion initiation occurred within shoot apices. Since temperatures fluctuate widely during the time the weevil feeds and the young larvae prefer the apical leaf for feeding, the above attributes enhance the value of these annuals as sources of resistance.

Loline content of tall fescue associated with summer fescue toxicosis - Lexington, Kentucky. Young cattle in temperature-controlled laboratories at 30° C to simulate summer stress conditions and fed seed containing 0.15% loline had significantly lower feed and water intake, and higher respiration rates and rectal temperatures than cattle fed seed containing 0 and 0.05% loline content. During the 21-day feeding trial, cattle fed seed containing

0, 0.05, and 0.15% loline showed a weight change of +17.0, +20.8, and -25.0 kg, respectively. Loline content of tall fescue forage during summer drought stress frequently attains levels of 0.15% dry matter and higher.

An endophytic fungus related to loline alkaloid content of tall fescue - Lexington, Kentucky. Eleven parental clones of the Kenhy variety were treated with benomyl, a systemic fungicide, to control the fungus *Epichloe typhina*. Seed of the treated clones had 70% less loline alkaloid content than seed of untreated clones. Mean loline levels of the treated clones varied from 86 to 1,216 µg/g for 10 clones, and one clonal line had 2,924 µg/g. Loline levels in seeds of the 11 untreated clones varied from 3,580 to 5,669 µg/g. Removal of *E. typhina* from tall fescue and the concomitant loline content in the forage could correct the summer fescue toxicosis problems and possibly double or triple the present animal production of the 1.5 to 2 million young cattle feeding on tall fescue.

Photosynthesis and chloroplast starch synthesis programmed by light period - Beltsville, Maryland. The rates of photosynthesis and starch accumulation in leaf chloroplasts of many plant species are programmed by the length of the daily photosynthetic and/or dark periods. Rates are higher in plants grown in short than in long photosynthetic periods. Furthermore, there is an acclimation in the rates when a plant is abruptly shifted to an environment with an altered photosynthetic period. Chloroplasts programmed with either high or low rates of photosynthesis and starch accumulation can be isolated and studied to identify those biochemical and biophysical factors that regulate the rates of photosynthesis and starch synthesis.

Relative yield of alfalfa plants is independent of competition - Beltsville, Maryland. Competition studies have shown that alfalfa plants ranked for yield at one level of competition have the same ranking at other levels of competition. Therefore, alfalfa plants selected for high yield in a spaced planting can be expected to be high yielding under sward conditions.

New race of anthracnose discovered on alfalfa - Beltsville, Maryland. Laboratory and greenhouse tests revealed that the anthracnose isolates found in 1978 as virulent on previously resistant Arc alfalfa are of a new race (Race 2) of *Colletotrichum trifolii*. This discovery represents the first occurrence of races of *C. trifolii* on alfalfa and requires a renewal of breeding efforts to develop resistance to Race 2. Plant pathologists will need to be alert to the occurrence of still more races in this organism and the occurrence of races in other alfalfa pathogens.

National program to research forage quality with near infrared reflectance spectroscopy established - Beltsville, Maryland. The site at BARC is one of six sites designated for the national research program. Research will be jointly conducted by scientists in the Instrumentation Research Laboratory and the Field Crops Laboratory. A coordinated program of forage quality research with each site participating in the overall goal has been initiated.



Techniques developed for screening for resistance to clover head weevil - Mississippi State, Mississippi. Resistance to the head weevil will assure reseeding stands of crimson clover without the use of pesticides to control the insect.

New technique for screening crimson clover for dinitrogen-fixation efficiency - Mississippi State, Mississippi. Inbred lines of five different cultivars of crimson clover (*Trifolium incarnatum* L.) were screened for dinitrogen fixation using acetylene reduction. The plants were inoculated with a pure culture of *Rhizobia trifolii* and grown for 8 weeks in plastic pouches. These pouches were later sealed and used for the assay procedure. Plants were grown under a light bank and live plants assayed under light, temperature, and moisture regimes used during growth. Plant top dry weights and root vigor scores were positively correlated with the acetylene reduction.

Forage quality of switchgrass improved by breeding - Lincoln, Nebraska. In vitro dry matter digestibility (IVDMD), was significantly improved in one cycle of selection and crossing. Over a 2-year period in seeded test plots, a high IVDMD strain selected from an experimental population was significantly higher in IVDMD than the leading cultivar Pathfinder and a low IVDMD selection from the same experimental population was lower in IVDMD than Pathfinder.

Improved method of establishing big bluestem and switchgrass - Lincoln, Nebraska. Establishing productive pastures has been the primary factor limiting the use of the native warm-season grasses, big bluestem, and switchgrass. It often has taken 2 or 3 years to obtain a usable stand. Productive stands of these grasses can be obtained in the establishment year for these grasses by using atrazine as a preemergence herbicide. Big bluestem and switchgrass plots treated with 3 lbs/acre of atrazine produced 1.9 and 3.8 tons/acre of harvestable forage the establishment year while untreated plots produced less than 0.4 tons/acre. These differences are economically significant with grass hay currently valued at \$40 to \$50/ton.

Six alfalfa germplasms developed that have resistance to four or more pests - Reno, Nevada. Three dormant germplasms were increased and are ready for release to the public. All three have high level resistance to common leaf spot as well as resistance to several other diseases and insects. Two of these germplasms have excellent agronomic characteristics as well as multiple pest resistance. Common leaf spot is the most serious foliar disease of alfalfa throughout the United States, thus elevating the significance of these contributions.

New procedure developed to induce root necrosis in white clover plants inoculated with *Fusarium* cultures - Oxford, North Carolina. Spraying inoculated plants with maleic hydrazide to inhibit plant growth caused root necrosis in short-term greenhouse tests. White clover clones varied from highly susceptible to highly resistant. No root necrosis developed without the use of the growth inhibitor. The use of maleic hydrazide should provide an effective means of screening for resistance to *Fusarium* root rot.

Anthracnose resistance found at several locations in North Carolina - Oxford and Raleigh, North Carolina. Surveys during the summer of 1979 show that isolates of the new race of *Colletotrichum trifolii* obtained from Davidson,



Rowan, and Iredell counties were highly virulent on Arc alfalfa. This suggests it will be necessary to incorporate resistance to these other races in adapted germplasm of Arc alfalfa.

Regenerated plants from cell culture will aid breeding programs - Mandan, North Dakota. Plantlets were obtained from cell masses (callus) that came from the male flower parts of a crested wheatgrass plant. This was the first reported case of regeneration of plants through cell culture in crested wheatgrass. The ability to produce plants from cell culture will help speed some processes in breeding programs. Haploid plants can be obtained so breeding and selection can be done at lower chromosome levels and vegetative propagation techniques can also be improved.

Efficient allocation of yield-testing sites accomplished through long-term study - Mandan, North Dakota. Five years of studying genotype-environment interactions for forage yield of 60 reed canarygrass clones has led to a recommendation that yield potential can be adequately assessed in the upper midwest by testing in only two States, Iowa and Missouri. Six States cooperated in the study. The number of yield-testing locations can now be reduced, but the effective information on yielding ability will not be appreciably decreased. If additional information is desired on persistence or broad adaptability, North Dakota can be added as the third testing site.

Improved methods for separation of protein isolates were developed - Philadelphia, Pennsylvania. Studies of fundamental processes which influence size-exclusion, ion exchange, and reversed phase chromatographic separations of proteins allowed selection of parameters which permitted separations in less than 30 minutes. Modification of electrophoresis techniques produced more reproducible gels.

Breeding procedures compared - University Park, Pennsylvania. Theoretical and experimental studies indicated that an increase in the number of parents per synthetic increased the mean of all synthetics and decreased the variance among synthetics. If attempts were made to find a high-yielding alfalfa cultivar by screening a large number of experimental synthetics (as is done with corn hybrids and small grain or soybean lines), greatest gains would be observed when the alfalfa synthetics have eight parents each. Gains with this approach probably would not be as great as with population improvement methods currently used in alfalfa breeding, however.

Maleic hydrazide treatment may induce apomictic seed production - University Park, Pennsylvania. Treatment of a facultatively apomictic buffelgrass line reduced the frequency of mature sexual embryo sacs and apparently increased the frequency of apomictic (asexual) embryo sacs. Treatment of a sexual grass line also inhibited sexual sac development and induced apparent apomixis.

Leafspot diseases found on warm-season grasses in Pennsylvania - University Park, Pennsylvania. Severe leafspot, caused by Ascochyta brachypodii and other fungi, was found on four of seven warm-season grass

species being evaluated for potential use in Pennsylvania. Artificial inoculations indicated that Caucasian bluestem and most cool-season forage species were highly resistant to A. brachypodii. Development of management measures for controlling diseases on warm-season species, or selection for resistant lines, are necessary before widespread planting of these species is encouraged.

Virus diseases reduce white clover yields - Clemson, South Carolina. Virus diseases (AMV, CYVV, and PSV) of white clover had detrimental effects on all of 16 growth components measured. Forage yields are reduced as much as 40% even if plants survive. Breeding lines have been developed that are three to five times more resistant to peanut stunt than the variety Ladino. Virus-resistant varieties will improve forage yields and persistence of stands.

ELISA technique improved - Clemson, South Carolina. The ELISA technique was refined and adapted to make it more applicable for use in research involving forage legume viruses. The modified technique provides a fast, efficient, and sensitive means of standardizing results from different locations and cooperating scientists. Quantitative ELISA readings of cross reactions of BYMV with CYVV, soybean mosaic virus, and blackeye cowpea mosaic virus indicated that serologically BYMV is more closely related to SMV and BCMV than to CYVV.

Obligate apomixis provides a way to incorporate genes from wild relatives into useful F<sub>1</sub> hybrids - College Station, Texas. When sexual plants were crossed with plants that reproduce by obligate apomixis, some of the hybrid offspring are obligate apomicts and breed true. This technique has been used for several years to develop apomictic true-breeding F<sub>1</sub> buffelgrass cultivars for commercial production. Results of new research indicate that it is possible to incorporate alien chromosomes into fertile apomictic F<sub>1</sub> hybrids that breed true. When an apomictic pentaploid buffelgrass containing an alien genome (nine unpaired chromosomes) was crossed with a sexual tetraploid (18 pairs of chromosomes), some apomictic F<sub>1</sub> hybrids containing alien chromosomes were produced. These hybrids breed true and produce good seed. This technique provides a way to introduce useful genes from wild relatives into apomictic species and permanently fix the new genotype and preserve fertility through obligate apomixis.

Tissue culture used to create variability in obligate apomictic species - Temple, Texas. In an effort to create variability in an obligate apomictic species, tissue culture techniques were used to circumvent the apomictic barrier to improvement. This approach capitalizes on the mitotic instability of aged callus tissue. Callus was produced from apomictic common dallisgrass, and more than 200 plantlets have been regenerated from the callus at this time. Preliminary observations of the callus-derived plants show morphological changes such as alteration of spikelet arrangement, increased pubescence, and change in anther color.

Higher quality lovegrass discovered - Temple, Texas. Low forage quality frequently limits animal performance of cattle grazing weeping lovegrass.

Several new lovegrass strains were found averaging 3 to 6 percentage units higher than the variety Morpa in in vitro dry matter disappearance (IVDMD). Morpa itself averages 3 to 4 percentage units higher than common in IVDMD and produces 12% higher animal gain. Thus, the new strains may have the potential to increase animal performance by 9% to 18% above Morpa, a potentially significant increase in beef production efficiency.

New blue grammas more efficient - Temple, Texas. When grown on a loamy sand soil in western Oklahoma at 0 and 37 kg/ha of nitrogen fertilizer, two experimental blue grammas were more efficient than other strains at converting added N to forage yield. Averaged over 3 years, WW-65 and NM-118 produced 60 kg/ha of forage for each kg/ha of nitrogen applied. The variety Lovington and other experimental strains produced only 40 kg/ha for each kg/ha applied. WW-65 and NM-118 were the highest producing strains with or without N fertilizer. However, especially with N fertilizers, they were lower in forage quality than Lovington.

Six experimental alfalfa lines (W25 Ve<sub>1</sub>, W37, W38, W39, W40, W125 R<sub>2</sub>W<sub>1</sub>Fu<sub>1</sub>) have combined resistance to bacterial wilt, Verticillium wilt, and stem nematodes - Prosser, Washington. One line has a good level of resistance to anthracnose. These lines have superior winter survival and forage yield in tests of comparison with currently available cultivars under attack by stem nematodes and Verticillium wilt. Germplasm release of two lines is anticipated in 1980.

Virulent Fusarium solani isolate identified - Madison, Wisconsin. This pathogen contributes to the lack of persistence in red clover by inciting certain forms of root rot in susceptible clover plants. The identified isolate, V148, will be used to survey red clover populations for resistant plants.

Technological Objective 2: New and improved cultural and management practices that increase forage crop yields, minimize production and utilization losses, improve feed quality, conserve and use scarce resources efficiently, and enhance environmental quality.

#### Research Locations:

Palmer Alaska  
Gainesville, Florida  
Tifton, Georgia  
Watkinsville, Georgia  
Peoria, Illinois  
Lafayette, Indiana  
St. Paul, Minnesota  
Mississippi State, Mississippi  
Columbia, Missouri  
Reno, Nevada  
Raleigh, North Carolina  
El Reno, Oklahoma  
University Park, Pennsylvania  
Prosser, Washington



#### Examples of Recent Progress:

N fertilization of tall fescue pastures reduces conception rate of beef cows - Watkinsville, Georgia. Cows grazing tall fescue fertilized with a low rate of nitrogen had a higher conception rate than cows grazing tall fescue pasture fertilized with 224 kg N/ha or higher. This effect on conception rate was most noticeable in cows which were recently introduced to the tall fescue pastures fertilized with the higher rates of nitrogen. This result confirms farmer experience relating poorer conception rates to higher rates of fertilization with poultry manure.

Triple intercrop forage system offers potential for increased beef cattle production on Piedmont lands - Watkinsville, Georgia. A triple intercrop system of tall fescue interseeded in summer with sorghum X sudangrass hybrid and in winter with rye improved yield and seasonal forage distribution, as well as provided species diversity for upgrading quality and quantity of grazing on highly erosive soils of the South and a workable technology for safely and rapidly converting poor stands of tall fescue into high-producing ones.

Significant progress in understanding N<sub>2</sub>-fixation in alfalfa - St. Paul, Minnesota. Greenhouse and field studies showed an 80% to 90% decline in N<sub>2</sub>-fixation capacity following shoot harvest. N<sub>2</sub>-fixation remained low for 10 to 13 days but increased as new shoot growth occurred. No massive loss of root nodules occurred after shoot removal. However, a rapid localized senescence occurred in nodules of harvested plants. This localized senescence was arrested as shoot growth resumed. Nodule nitrate reductase was inversely related to N<sub>2</sub>-fixation. These studies show why N<sub>2</sub>-fixation is very efficient in alfalfa.

Explanation of slow alfalfa nodulation in Minnesota soils - St. Paul, Minnesota. Nodules of alfalfa, which are essential to effective nitrogen fixation by the crop, often form slowly in the seeding year after conventional inoculation or seed coating. Investigation of this phenomenon showed that indigenous levels of soil nitrogen from organic matter decomposition, or higher levels of soil nitrogen from carryover fertilizer, may frequently inhibit alfalfa nodulation in the springtime. Thus, lack of nodulation should not be ascribed to a poor inoculum preparation or to inadequate plant nutrition until the soil nitrogen status has been investigated. The results suggest the possibility of selecting alfalfa genotypes that nodulate and start nitrogen fixation more rapidly in midwestern soils that have relatively high nitrogen availability.

New low-alkaloid line of reed canarygrass gives increased gains of grazing lambs - St. Paul, Minnesota. Cooperative research by USDA-SEA-AR and the University of Minnesota has produced a line of reed canarygrass (MN-76 that had only 0.15% or less indole alkaloids compared to as high as 0.42% or 0.33% in currently marketed 'Rise' or 'Vantage' during several 28-day grazing periods in 1978 and 1979. A negative correlation occurred between indole alkaloid concentration of the three grasses and daily weight gains of grazing lambs during each of the 2 years. The reduced alkaloids of MN-76 were



accompanied by from 42% to 69% higher average daily gains. This indicates that MN-76 is a significant breeding advance, which can be directly beneficial to sheep producers. New experiments are in progress to test cattle response to the new line.

New pasture legume diseases identified in Mississippi - Mississippi State, Mississippi. Producers have frequently encountered problems in keeping clovers established in pastures and in maintaining their high productivity. Several important diseases that attack pasture legumes in the South have been identified and are considered likely causes for many crop failures. Recognition of specific causes for failures or decreases in productivity of legumes in pastures is essential to the development of new, improved varieties with increased survival, productivity, and  $N_2$  fixation.

Legumes benefit animal performance under grazing conditions - Columbia, Missouri. In grazing trials at Columbia, Missouri, the 3-year average shows that production of beef from tall fescue-legume pastures will equal or exceed animal production from tall fescue pastures which are annually fertilized with 141 kg N/ha (125 lb N/A) at a cost of nearly \$62/ha. Average daily gain (ADG) of Hereford X Angus steers was 31% greater on 'Kentucky 31' tall fescue pastures sod-seeded with 'Empire' birdsfoot trefoil or 'Kenstar' red clover as compared to tall fescue grown alone and fertilized with 141 kg N/ha. Cattle gains per ha were not statistically different among nitrogen-fertilized fescue and fescue-legume pastures.

Allelopathic substances in herbage of tall fescue inhibit seedling development of birdsfoot trefoil - Columbia, Missouri. Lactic and succinic acids were identified as the major inhibitors present in fresh and stockpiled herbage. However, other organic acids (malic, citric, shikimic, glyceric, fumaric, and quinic) plus several unknown substances also inhibited trefoil development. Root development was more severely inhibited than was germination or hypocotyl growth. Field and laboratory studies show that burning of fescue residue (destroying the inhibitors) improves the establishment of sod-seeded trefoil.

Legume root types are a heritable characteristic - University Park, Pennsylvania. These results indirectly confirm earlier studies that the slantboard technique could be useful to identify types of plants. This technique would eliminate much of the variability associated with field work and permit year-round study.

Meadow voles useful in forage alkaloid studies - University Park, Pennsylvania. Alkaloids common to reed canarygrass (hordenine sulfate) were not toxic to meadow voles when fed at concentrations that may be expected to occur in the grass. There are very few studies of hordenine, and these results should be useful to plant breeders interested in altering the alkaloids in reed canarygrass.

Establishment of alfalfa enhanced through the use of CGA-48988 - Reno, Nevada. This systemic fungicide has specific activity against the group of fungi including Pythium and Phytophthora. The chemical can be effectively

used as a seed treatment as well as a soil drench at seeding. These results may lead to better stand establishment with lower seeding rates.

A new forage offers producers an improved alternative for livestock feed - Raleigh, North Carolina. *Pennisetum flaccidum* has been found to be lower in fiber compared with other tropical forages. It is relished by animals and has resulted in steer daily gains of 0.23 kg more than from a conventional tall fescue-Coastal bermudagrass system.

Legumes replace commercial nitrogen fertilizers in forage seedings - University Park, Pennsylvania. Planting of alfalfa, red clover, and birds-foot trefoil into established grasses show that these legume-grass mixtures, properly managed, are as productive as grasses alone which receive up to 300 pounds of nitrogen per acre annually. Use of commercial nitrogen fertilizers in grassland production can be greatly curtailed, resulting in reduced expenditures by farmers and in conservation of natural gas used in nitrogen-fertilizer production.

Successful establishment of legumes in grass obtained without use of herbicides - University Park, Pennsylvania. Minimum-tillage seeding of alfalfa and red clover into established grass with and without herbicides show that legume establishment and total herbage yields have been essentially equal, irrespective of herbicide use. One extra clipping of grass above the developing legume seedlings was made in no-herbicide plots to reduce competition from the grass. These results confirm those of researchers working further south and demonstrate potential savings in legume establishment costs, provided rational clipping and/or grazing techniques are employed during the establishment phase.

Spread of Verticillium wilt - Prosser, Washington. Greenhouse, laboratory, and field tests indicate that 2-week-old alfalfa seedlings are not as easily infected by *Verticillium albo-atrum* as older plants. The Verticillium wilt organism can be readily spread by wind, water, and infected hay.

New root-knot nematode (*Meloidogyne* sp.) identified in the Northwest - Prosser, Washington. A new root-knot nematode has been discovered attacking potato in the Pacific Northwest. Limited surveys indicate this nematode is in Washington, Idaho, and Oregon, where it has been found attacking potato, and in corn and wheat fields. It is of particular economic importance because corn and wheat are used in rotation with potato, as well as alfalfa which appears to support low populations.

Legume forage yields not affected by long-term subfreezing seed storage - Prosser, Washington. Seed of seven legume varieties stored in freezer for 14 to 18 years at about 5° F produced as much forage as did genetically identical fresh seed of the same varieties except for one seed lot of tetraploid alsike clover with 22% germination following storage. It was concluded that forage yields would not be affected by long-term subfreezing seed storage if the seed were of good germination following storage.

Technological Objective 3: New and improved cultural and management practices that increase forage crop and turfgrass seed yield, reduce production losses, and improve seed quality.

Research Locations:

Palmer, Alaska  
Tifton, Georgia  
Lafayette, Indiana  
Stillwater, Oklahoma  
Corvallis, Oregon  
Prosser, Washington  
Pullman, Washington

Examples of Recent Progress:

Genetic shift during seed production can be minimized - Lafayette, Indiana. Evaluations of forage crop seed produced in western regions of the United States have shown that deleterious changes in varietal characteristics can occur during seed multiplication. Limiting the number of generations of seed increase has been the most effective means of reducing deleterious changes. Specifying management practices so as to expose seed-producing fields to a semblance of the climatic conditions prevalent in the area of varietal adaptation is the second most effective means of minimizing varietal changes. Application of these principles to seed production management has resulted in commercial supplies of forage seed with essentially the same characteristics as those of the original breeder seed.

Improved grass seed harvester developed - Stillwater, Oklahoma. A flail-type seed stripper was developed for harvesting seed of chaffy-seeded range grasses, specifically the Old World bluestems. The machine's harvesting efficiency is superior to other methods. A commercial version of the machine is now being manufactured. This machine eliminates one of the biggest grower bottle-necks in producing seed of these grasses. A plentiful and constant commercial seed supply of an improved grass strain is very important if years of breeding and research are to result in its widespread use and benefit.

Ergot and blind seed disease controlled - Corvallis, Oregon. Complete control of ergot and 99 percent control of blind seed disease was demonstrated by a single application of sodium azide at 10 pounds actual ingredient per acre applied May 18. Control lasted through anthesis of perennial ryegrass plants.

Technological Objective 4: Turfgrass cultivars and genetic populations with increased pest resistance, tolerance to environmental stress, and improved agronomic characteristics.



Technological Objective 5: Improved cultural and management practices for turfgrasses that reduce the costs of maintenance, increase ground cover value, provide greater persistence, and improve aesthetics.

Research Locations:

Palmer, Alaska  
Tifton, Georgia  
Lexington, Kentucky  
Beltsville, Maryland (PGGI)

Examples of Recent Progress:

New methods to screen germplasm rapidly for disease resistance developed - Beltsville, Maryland. Rapid, reliable procedures were established for screening tall fescue, red fescue, and perennial ryegrass in the greenhouse for resistance to Dreuchlera dictyoides, Rhizoctonia solani, and Bipolaris sorokiniana. These techniques will significantly increase progress in our grass breeding program for increased pest resistance.

Preemergence herbicides reduce winter survival of bermudagrass - Beltsville, Maryland. Preemergence herbicides recommended to control grassy weeds (crabgrass) in bermudagrass turf were shown to increase winterkill at temperatures which the species would normally survive. Herbicide and time of application were shown to be important considerations in reducing the injurious effects. This information will be useful in reducing winterkill of bermudagrass in northern areas of its adaptation.

New turfgrass disease identified - Beltsville, Maryland. Two highly virulent biotypes of Sclerotium rolfsii were identified as incitants of a previously unreported disease on annual bluegrass. Early identification of the disease will be useful in developing control methods before the disease becomes epidemic.



## P U B L I C A T I O N S

### Palmer, Alaska

Brundage, A. L., R. L. Taylor, and V. L. Burton. 1979. Relative yields and nutritive values of barley, oats, and peas harvested at four successive dates for forage. *J. Dairy Sci.* 62:740-745.

Klebesadel, L. J. 1980. Birdvetch (Vicia cracca L.): Forage crop, ground cover, ornamental, or weed? *Agroborealis*. 12(1):46-49.

Washburn, R. H., L. J. Klebesadel, J. S. Palmer, J. R. Luick, and D. P. Bleicher. 1980. The warble-fly problem in Alaskan reindeer. *Agroborealis*. 12(1):23-28.

### Tifton, Georgia

Bailey, A. V., B. Piccolo, G. Sumrell, and G. W. Burton. 1979. Amino acid profiles, chemical scores, and mineral contents of some pearl millet inbred lines. *J. Agr. Food Chem.* 27(6):1421-1423.

Bailey, A. V., G. Sumrell, and G. W. Burton. 1979. Pentosans in pearl millet. *Cereal Chem.* 56(4):295-298.

Bouton, J. H., R. H. Smith, S. C. Schank, G. W. Burton, M. E. Tyler, R. C. Littell, R. N. Gallaher, and K. H. Quesenberry. 1979. Response of pearl millet inbreds and hybrids to inoculation with Azospirillum brasilense. *Crop Sci.* 19(1):12-16.

Burton, G. W. 1979. Handling cross-pollinated germplasm efficiently. *Crop Sci.* 19(5):685-690.

Burton, G. W. 1979. New Bermudas. *Proc. GCSAA 50th Internatl. Turfgrass Conf. and Show, Atlanta, Ga.* p. 22-26.

Hanna, W. W. 1979. Interspecific hybrids between pearl millet and fountain-grass. *J. Heredity* 70:425-427.

Hanna, W. W., T. P. Gaines, and W. G. Monson. 1979. Seed set and d<sub>2</sub> gene effects on pearl millet forage quality. *Agron. J.* 71:1027-1029.

Johnson, J. C., Jr., W. C. McCormick, W. H. Marchant, R. E. Hellwig, G. W. Burton, and J. L. Butler. 1979. Characterization by animal performance of hay and pellets made from Tifton 44 bermudagrass. *Univ. of Georgia Res. Rept.* 301.

Miller, J. D. 1980. Registration of Virginia Synthetic A crownvetch germ-plasm. Crop Sci. May-June issue. 20:418.

Miller, J. D. and I. Forbes, Jr. 1979. Seed collections of forage legume species. Proc. Sixth Trifolium Conf., Univ. of Wisconsin, Madison. p. 29-34.

Wells, H. D. 1979. Breeding for disease and freeze resistance in blue lupines. Proc. 36th Southern Pasture and Forage Crop Improvement Conf. May 1-3, Beltsville, MD. p. 101-104.

Rabson, R., W. W. Hanna, G. W. Burton, and H. Axmann. 1979. Potential for improving the protein content of pearl millet grain using induced mutations. In Seed Protein Improvement in Cereals and Grain Legumes, Vol. II, IAEA-SM-230/65:367-376.

#### Peoria, Illinois

Bush, L. P., J. A. Boling, and S. G. Yates. 1979. Animal disorders. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:247-292.

Yates, S. G., J. A. Rothfus, G. B. Garner, and C. N. Cornell. 1979. Videothermometry for assay of fescue foot in cattle. Amer. J. Vet. Res. 40(8):1192-1196.

#### Manhattan, Kansas

Kreitner, G. L. and E. L. Sorensen. Glandular secretory system of Medicago species. Crop Sci. 79:499-502.

Kreitner, Gerald L. and E. L. Sorensen. 1979. Glandular trichomes on Medicago species. Crop Sci. 19:380-384.

#### Lexington, Kentucky

Asay, K. H., R. V. Frakes, and R. C. Buckner. 1979. Breeding and cultivars. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:111-139.

Berg, C. C., R. R. Hill, Jr., R. C. Buckner, and R. F. Barnes. Forage production and quality of synthetics derived from Lolium X Festuca hybrids. Crop Sci. 19:89-93.

Buckner, R. C., L. P. Bush, and P. B. Burrus, II. 1979. Succulence as a selection criterion for improved forage quality in Lolium-Festuca hybrids. Crop Sci. 19:93-96.

Buckner, R. C., J. B. Powell, and R. V. Frakes. 1979. Historical development. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:1-7.

Hemken, R. W., L. S. Bull, J. A. Boling, E. Kane, L. P. Bush, and R. C. Buckner. 1979. Summer fescue toxicosis in lactating cows and sheep fed experimental strains of ryegrass-tall fescue hybrids. J. Anim. Sci. 49:641-646.

Kasperbauer, M. J., R. C. Buckner, and L. P. Bush. 1979. Tissue culture of annual ryegrass X tall fescue F<sub>1</sub> hybrids: Callus establishment and plant regeneration. Crop Sci. 19:457-460.

Steen, W. W., N. Gay, J. A. Boling, R. C. Buckner, L. P. Bush, and G. Lacefield. 1979. Evaluation of Kentucky 31, G1-306, G1-307, and Kenhy tall fescue as pasture for yearling steers. II. Growth, physiological response and plasma constituents of yearling steers. J. Anim. Sci. 48:618-623.

Steen, W. W., N. Gay, J. A. Boling, G. Lacefield, L. P. Bush, and R. C. Buckner. 1979. Evaluation of Kentucky 31, G1-306, G1-307, and Kenhy tall fescue as pasture for yearling steers. I. Forage composition. J. Anim. Sci. 48:607-617.

#### Beltsville, Maryland

Brown, D. E., W. R. Kehr, G. R. Manglitz, and J. H. Elgin, Jr. 1979. Contamination on contiguous borders in alfalfa seed production fields. Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978. USDA-SEA--ARM-NC-7. p. 24.

Buckner, R. C., R. V. Frakes, and J. B. Powell. 1979. Historical development of tall fescue. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:1-8.

Chatterton, N. J., and J. E. Silviu. 1979. Photosynthate partitioning into starch in soybean leaves. I. Effects of photoperiod versus photosynthetic period duration. Plant Physiol. 64:749-753.

Elgin, J. H., Jr. 1979. Alfalfa breeding research at the Beltsville Agricultural Research Center. Proc. 36th Southern Pasture and Forage Crop Improvement Conf., May 1-3, Beltsville, MD. p. 30-31.

Elgin, J. H., Jr. 1980. Anthracnose resistance means increased yields. Proc. Third Eastern Forage Improvement Conf., Ottawa, Can., July 10-12, 1979. p. 40.

Elgin, J. H., Jr. 1979. Inheritance of stem-nematode resistance in alfalfa. Crop Sci. 19:353-354.

Elgin, J. H., Jr. 1979. A Federal research perspective on alfalfa breeding in the Southern Region. Proc. 36th Southern Pasture and Forage Crop Improvement Conf., May 1-3, Beltsville, MD. p. 100.

Elgin, J. H., Jr., and J. E. McMurtrey, III. Aluminum-tolerant alfalfa--Status for 1978. 1979. Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978. USDA-SEA--ARM-NC-7. p. 33.

- Hartman, B. J., O. J. Hunt, J. H. Elgin, Jr., R. N. Peaden, and B. D. Thyr. 1979. Registration of Washington SNI alfalfa germplasm. *Crop Sci.* 19:416.
- Hornick, S. B., J. J. Murray, R. L. Chaney, L. J. Sikora, J. F. Parr, W. D. Burge, G. B. Willson, and C. F. Tester. 1979. Use of sewage sludge compost for soil improvement and plant growth. USDA-SEA--ARM-NE-6.
- McMurtrey, J. E., III, J. H. Elgin, Jr., S. A. Ostazeski, and R. H. Ratcliffe. 1979. Registration of Beltsville-6, a semi-dormant alfalfa germplasm. *Crop Sci.* 19:931.
- Murray, J. J. 1978. Better Lawns. U.S. Dept. Agr., Home & Garden Bul. 51 Revised.
- Murray, J. J. 1978. Differential response of turf varieties to lime and aluminum. *Proc. 17th Virginia Turfgrass Conf.*, MA 216, p. 11-13.
- Murray, J. J. 1978. Use of composted sewage sludge in turfgrass production. *Proc. Wastewater Conf. Amer. Soc. Golf Course Archit. Found., Green Sec. U.S. Golf Assoc., Natl. Golf Found. and Golf Course Supt. Assoc. of Amer.*, Nov. p. 132-146.
- Murray, J. J. and C. D. Foy. 1978. Differential tolerances of turfgrass cultivars to an acid soil high in exchangeable aluminum. *Agron. J.* 70:769-774.
- Murray, J. J. and J. B. Powell. Turf. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:293-306.
- Ostazeski, S. A. and J. H. Elgin, Jr. 1980. An update on anthracnose, fusarium wilt, root-rot nematode and root rot studies on alfalfa at Beltsville. *Proc. Third Eastern Forage Improvement Conf.*, Ottawa, Can., July 10-12, 1979. p. 28.
- Ostazeski, S. A., J. H. Elgin, Jr., and J. E. McMurtrey III. 1979. Occurrence of anthracnose on formerly anthracnose-resistant 'Arc' alfalfa. *Plant Dis. Reptr.* 63:734-736.
- Powell, J. B. 1979. Turfgrass development for specific uses through breeding. *Proc. Bicentennial Symp. Turfgrass DIV C-5. Crop Sci. Soc. Amer.* p. 6-11.
- Powell, J. B. and J. Bond. 1979. Summer syndrome of cattle grazing experimental strains of tall fescue. *Proc. 36th Southern Pasture and Forage Improvement Conf.*, Beltsville, MD. May 1-3. p. 1-2.
- Powell, J. B., J. J. Murray, N. R. O'Neill, and R. H. Ratcliffe. 1979. Forage and turfgrass breeding at the Beltsville Agricultural Center. *Proc. 25th Grass Breeders Work Planning Conf.*, Lexington, KY. p. 22A.



Rothbart, H. L., J. H. Elgin, Jr., S. B. Jones, R. A. Barford, P. Magidman, B. J. Mays, B. J. Sliwinski, and J. E. McMurtrey III. 1979. Some chemical and physical observations on alfalfa genotypes resistant to Uromyces striatus. Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978. USDA-SEA--ARM-NC-7. p. 41.

Silvius, J. E., N. J. Chatterton, and D. F. Kremer. 1979. Photosynthate partitioning in soybean leaves at two irradiance levels. Comparative responses of acclimated and unacclimated leaves. Plant Physiol. 64:872-875.

Tucker, C. J., J. H. Elgin, Jr., and J. E. McMurtrey III. 1979. Relationship of red and photographic infrared spectral radiances to alfalfa biomass, forage water content, percentage canopy cover, and severity of drought stress. NASA Technical Memorandum 30272, Goddard Space Flight Center, Greenbelt, MD 20771. April (Tech. Rept.)

Tucker, C. J., J. H. Elgin, Jr., J. E. McMurtrey III, and C. J. Fan. 1979. Monitoring corn and soybean crop development with hand-held radiometer spectral data. Remote Sensing of Environment 8:237-248.

Tucker, C. J., J. H. Elgin, Jr., and J. E. McMurtrey III. 1979. Temporal spectral measurements of corn and soybean crops. Photogrammetric Engineering and Remote Sensing 45:643-653.

Tucker, C. H., B. N. Holben, J. H. Elgin, Jr., and J. E. McMurtrey III. 1979. The relationship of red and photographic infrared spectral data to grain yield variation within a winter wheat field. NASA Technical Memorandum 80318. Goddard Space Flight Center, Greenbelt, MD. July. (Tech. Rept.)

#### St. Paul, Minnesota

Barnes, D. K. 1978. Increased nitrogen fixation by bacteria and plants. Proc. Twenty-Fourth Farm Seed Conf. p. 28-33.

Barnes, D. K., F. I. Frosheiser, and N. P. Martin. 1979. Choosing the best alfalfa varieties. Proc. 4th Ann. Symp. Minnesota Forage and Grassland Council. p. 34-40.

Barnes, D. K., C. P. Vance, and G. H. Heichel. 1979. Seed coating and nodulation effectiveness in alfalfa. Proc. Ninth Ann. Alfalfa Symp. p. 1-10.

Barnes, R. F and G. C. Marten. 1979. Recent developments in predicting forage quality. J. Anim. Sci. 48:1554-1560.

Cralle, H. T. 1979. Nitrogen fixation and regrowth of alfalfa (Medicago sativa L.) and birdsfoot trefoil (Lotus corniculatus L.) after harvest and debudding. M.S. Thesis. Univ. of Minnesota. 36 p.

Graham, J. H., F. I. Frosheiser, D. L. Stuteville, and D. C. Erwin. 1979. A compendium of alfalfa diseases. Amer. Phytopath. Soc., St. Paul, MN. 65 p.

- Hartman, B. J., O. J. Hunt, F. I. Frosheiser, S. A. Ostazeski, D. K. Barnes, R. N. Peaden, and B. D. Thyr. 1979. Registration of NMP-8 and NMP-10 nondormant alfalfa germplasms (Reg. No. GP 97 and 98). *Crop Sci.* 19:46.
- Heichel, G. H. 1979. Energy use in agriculture. *Proc. Twenty-Fourth Annual Farm Seed Conf., Amer. Seed Trade Assn.* 24:12-27.
- Heichel, G. H., D. K. Barnes, and C. P. Vance. 1979. Energy balance of alfalfa production. *Proc. Ninth Annual Alfalfa Symposium, Peoria, IL.* p. 11-21.
- Heichel, G. H., C. C. Sheaffer, C. P. Vance, and D. K. Barnes. 1979. Alfalfa nodulation, establishment, weed control, and yields with coated seed. *Proc. Fourth Ann. Symp., Minnesota Forage and Grassland Council, Rochester, MN.* p. 6-14.
- Heichel, G. H. and C. P. Vance. 1979. Nitrate-N and Rhizobium strain roles in alfalfa seedling nodulation and growth. *Crop Sci.* 19:513-518.
- Hovin, A. W. and G. C. Marten. 1979. Predicting forage digestibility from quality traits. *Proc. Grass Breeders Work Planning Conf., Lexington, KY.* p. 9.
- Knous, T. R. 1979. Implications of phytosterols in alfalfa roots associated with *Phytophthora* root. Ph. D. Thesis, Univ. of Minnesota, St. Paul, MN. 148 p.
- Marten, G. C. and R. F. Barnes. 1980. Prediction of energy digestibility of forages with in vitro rumen fermentation and fungal enzyme systems. *Proc. Internatl. Workshop Standardization Anal. Methodology Feeds. IDRC-134e, Ottawa, Can.* p. 61-71.
- Marten, G. C., C. E. Clapp, and W. E. Larson. 1979. Effects of municipal wastewater effluent and cutting management on persistence and yield of eight perennial forages. *Agron. J.* 71:650-658.
- Marten, G. C., W. E. Larson, and C. E. Clapp. 1980. Effects of municipal wastewater effluent on performance and feed quality of maize vs. reed canarygrass. *J. Environ. Qual.* 9:137-141.
- Marum, P., A. W. Hovin, and G. C. Marten. 1979. Inheritance of three groups of indole alkaloids in reed canarygrass. *Crop Sci.* 19:539-544.
- Marum, P., A. W. Hovin, G. C. Marten, and J. S. Shenk. 1979. Genetic variability for cell wall constituents and associated quality traits in reed canarygrass. *Crop Sci.* 19:355-360.
- Oelke, E. A. and G. C. Marten. 1979. Wild rice residue is potential beef cow feed. *Minn. Forage Update Vol. IV, No. 4.* p. 1.

Teuber, L. R. and D. K. Barnes. 1979. Breeding alfalfa for increased nectar production. Prov. IVth Symp. on Pollination, MD Agr. Expt. Sta. Misc. Pub. 1:109-116.

Teuber, L. R. and D. K. Barnes. 1979. Environmental and genetic influences on alfalfa nectar. Crop Sci. 19:874-878.

Thyr, B. D., D. K. Barnes, F. I. Frosheiser, O. J. Hunt, R. N. Peaden, and B. J. Hartman. 1979. Registration of MSE<sub>6</sub> SN<sub>3</sub> W<sub>3</sub> and MSF<sub>6</sub> SN<sub>3</sub> W<sub>3</sub> alfalfa germplasms. (Reg. Nos. GP 100 and GP 101). Crop Sci. 19:417.

Vance, C. P., G. H. Heichel, D. K. Barnes, J. W. Bryan, and L. E. Johnson. 1979. Nitrogen fixation, nodule development and vegetative regrowth of alfalfa (Medicago sativa L.) following harvest. Plant Physiol. 64:1-8.

Viands, D. R. 1979. Selection experiments on nitrogen fixation in alfalfa. Ph. D. Thesis, Univ. of Minnesota, St. Paul, MN. 75 p.

Viands, D. R., D. K. Barnes, R. E. Stucker, and F. I. Frosheiser. 1979. Inheritance of resistance to bacterial wilt in two alfalfa genepools: response to selection and quantitative analysis. Crop Sci. 19:711-714.

Viands, D. R., C. P. Vance, G. H. Heichel, and D. K. Barnes. 1979. An ineffective nitrogen fixation trait in alfalfa. Crop Sci. 19:905-908.

Volz, M. G. and G. H. Heichel. 1979. Nitrogen transformations and microbial population dynamics in soil amended with fermentation and residue. J. Environ. Qual. 8:434-439.

Woods, D. L., A. W. Hovin, and G. C. Marten. 1979. Seasonal variation of hordenine and gramine concentration and their heritabilities in reed canarygrass. Crop Sci. 19:853-857.

#### Mississippi State, Mississippi

Hagedorn, C. 1979. Host-plant specificity, antibiotic resistance patterns and serological relationships of selected Rhizobium trifolii isolates. Proc. 6th Aust. Legume Nodulation Conf., Perth, 21-24. Aug. p. 1-4.

Hagedorn, C. 1979. Nodulation of Trifolium subterraneum L. by introduced rhizobia in southwest Oregon soils. Soil Sci. Soc. Amer. J. 43:515-519.

Hagedorn, C. 1979. Relationship of antibiotic-resistance to effectiveness in Rhizobium trifolii populations. Soil Sci. Soc. Amer. J. 43:921-925.

Kimbrough, E. L., W. E. Knight, and C. Hagedorn. 1979. Inoculating forage legumes. MCES Info. Sheet 1083. 2 p.

Knight, W. E. 1979. Role of legumes in a quality forage program. Proc. Five States Forage Conf., Shreveport, LA. March 6. p. 26-39.

Knight, W. E. and R. G. Pratt. 1979. Improvement of winter-annual clovers at Mississippi State. Sixth Trifolium Conf., Univ. of Wisconsin, Madison. June 26-27. p. 11-12.

Knight, W. E. and R. G. Pratt. 1979. Research on disease and insect problems of winter-annual clovers in Mississippi. Sixth Trifolium Conf., Univ. of Wisconsin, Madison. June 26-27. p. 70-71.

Pratt, R. G. 1979. Soilborne diseases of annual clovers in the South and methods of screening for resistance. Proc. 36th Southern Pasture and Forage Crop Improvement Conf., Beltsville, MD. May 1-3. p. 70-75.

#### Columbia, Missouri

Matches, A. G. 1979. Management of tall fescue. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph, 1st edition. Amer. Soc. Agron., Madison, WI. 20:171-199.

Matches, A. G. and D. Mowery. 1979. Legumes frost-seeded into sods of switchgrass and caucasion bluestem. Res. Rept. 1979. Southwest Missouri Center, Mt. Vernon, MO, College of Agr. Spec. Rept., 238. p. 9-14.

Matches, A. G., S. Bell, D. Mowery, and F. A. Martz. 1979. Management of caucasian bluestem in pasture systems. Res. Rept. 1979. Southwest Missouri Center, Mt. Vernon, MO, College of Agr. Spec. Rept. 238. p. 8.

Matches, A. G., D. Mowery, and D. A. Sleper. 1979. Management of tall fescue cultivars grown with legumes. Res. Rept. 1979. Southwest Missouri Center, Mt. Vernon, MO, College of Agr. Spec. Rept. 238. p. 15-34.

Matches, A. G. and W. R. Ocumpaugh. 1979. Trends in potassium concentration of autumn-stockpiled tall fescue. Better Crops with Plant Feed. LXIII. (Spring 1979):11.

Stratton, S. D., D. A. Sleper, and A. G. Matches. 1979. Genetic variation and interrelationships of in vitro dry matter disappearance and fiber content in orchardgrass herbage. Crop Sci. 19:329-333.

Stricker, J. A., A. G. Matches, G. G. Thompson, V. E. Jacobs, F. A. Martz, H. N. Wheaton, H. D. Currence, and G. F. Krause. 1979. Cow-calf production on tall fescue-Ladino clover pastures with and without nitrogen fertilizer or creep feeding: Spring calves. J. Anim. Sci. 48:13-25.

#### Lincoln, Nebraska

Brown, D. E., W. R. Kehr, G. R. Manglitz, and J. H. Elgin, Jr. 1979. Contamination on contiguous borders. Rept. 26th Alfalfa Improvement Conf. South Dakota State Univ., Brookings, June 6-8, 1978. USDA-SEA--ARM-NC-7. p. 24.



- Clark, R. B., H. J. Gorz, and F. A. Haskins. 1979. Effects of mineral elements on hydrocyanic acid potential in sorghum seedlings. *Crop Sci.* 19:757-761.
- Gorz, H. J., F. A. Haskins, Richard Dam, and K. P. Vogel. 1979. Dhurrin in Sorghastrum nutans. *Phytochemistry* 18:2024.
- Gorz, H. J., F. A. Haskins, and C. O. Gardner. 1979. Heritability of hydrocyanic acid potential in Greenleaf sudangrass. *Sorghum Newsletter* 22:28.
- Gorz, H. J., G. R. Manglitz, and F. A. Haskins. 1979. Red clover--yellow clover aphid and pea aphid. *Annual Plant Resistance to Insects Newsletter* 5:24.
- Gorz, H. J., G. R. Manglitz, and F. A. Haskins. 1979. Registration of N-2 red clover germplasm. *Crop Sci.* 19:417-418.
- Gorz, H. J., G. R. Manglitz, and F. A. Haskins. 1979. Selection for yellow clover aphid and pea aphid resistance in red clover. *Crop Sci.* 19:257-260.
- Gorz, H. J., J. K. Rutto, W. M. Ross, and F. A. Haskins. 1979. Preliminary evaluation of grain sorghum hybrids and lines for residue yield and quality. *Sorghum Newsletter* 22:100-101.
- Haskins, F. A., H. J. Gorz, and R. L. Nielsen. 1979. Comparison of the hydrocyanic acid potential of sorghum seedlings and tillers. *Agron. J.* 71:501-504.
- Haskins, F. A., H. J. Gorz, and K. P. Vogel. 1979. Cyanogenesis in indiangrass seedlings. *Crop Sci.* 19:761-765.
- Kehr, W. R. and R. L. Ogden. 1979. Management of established stands of alfalfa for dehydration. *Proc. Second Intl. Green Crop Drying Congress, Univ. of Sask., Sask., Can.* p. 112-129.
- Kehr, W. R., R. L. Ogden, and L. D. Satterlee. 1979. An alfalfa protein concentrate from four cultivars at three growth stages. *Agron. J.* 71:272-275.
- Kehr, W. R., R. L. Ogden, and R. C. Sorensen. 1979. Field performance of Rhizobium inoculation methods on two alfalfa varieties. *Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978.* USDA-SEA--ARM-NC-7. p. 26.
- Kehr, W. R., R. C. Sorensen, and J. C. Burton. 1979. Field performance of 12 strains of Rhizobium on 4 alfalfa varieties. *Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978.* USDA-SEA--ARM-NC-7. p. 25.

Ogden, R. L., W. R. Kehr, and L. D. Satterlee. 1979. Alfalfa protein concentrate in relation to variety and growth stage. Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978. USDA-SEA--ARM-NC-7. p. 37.

Palmer, Louis T. and W. R. Kehr. 1978/1979. Evaluation of selected fungicides for the control of seedling blight in lucerne. Protection Ecology 1:211-214.

Ross, W. M., H. J. Gorz, F. A. Haskins, and K. D. Kofoed. 1979. Combining ability in forage sorghum hybrids. Maydica XXIV:83-93.

Thyr, B. D., W. R. Kehr, G. R. Manglitz, B. J. Hartman, and O. J. Hunt. 1979. Development of multiple pest resistance in three alfalfa populations. Rept. 26th Alfalfa Improvement Conf., South Dakota State Univ., Brookings, June 6-8, 1978. USDA-SEA--ARM-NC-7. p. 17.

Vogel, K. P., F. A. Haskins, and H. J. Gorz. 1979. Improving switchgrass as a forage crop. Proc. 25th Grass Breeders Work Planning Conf., Lexington, KY. p. 8

Vogel, K. P. and J. H. Riesselman. 1979. Control of damping off in range-grass seedlings, 1977. Fungicide and Nematicide Tests 34:147.

Watkins, J. E. and W. R. Kehr. 1979. Effect of anthracnose on alfalfa production. Proc. 1979 Crop Protection Clinics. Ext. Serv., Neb. Agr. Expt. Sta. p. 50-53.

#### Reno, Nevada

Hartman, B. 1979. Alfalfa breeding and the Plant Variety Protection Act. 10th Ann. Interstate Alfalfa Seed Growers School, Oregon State Univ., held at Ontario, OR. p. 8-9.

Hartman, B. J., O. J. Hunt, J. H. Elgin, Jr., R. N. Peaden, and B. D. Thyr. 1979. Registration of Washington SNI alfalfa germplasm. Crop Sci. 19:416.

Hartman, B. J., O. J. Hunt, F. I. Frosheiser, S. A. Ostazeski, D. K. Barnes, R. N. Peaden, and B. D. Thyr. 1979. Registration of NMP-8 and NMP-10 nondormant alfalfa germplasm. Crop Sci. 19:416.

Hartman, B. J., O. J. Hunt, R. N. Peaden, H. J. Jensen, B. D. Thyr, L. R. Faulkner, and G. D. Griffin. 1979. Registration of Nevada Synthetic YY nondormant alfalfa germplasm. Crop Sci. 19:416-417.

Hartman, B. J. and L. Tuteur. 1979. Seed increase of alfalfa plant introductions and germplasm. Proc. Nevada Committee on Conservation of Plant Materials. Univ. of Nevada, Reno.

Melton, B., C. Straley, F. Dane, B. Hartman, R. Hallend, R. Ditterline, and J. Aguirre. 1979. Inbreeding, environmental effects and combining ability studies in alfalfa. New Mexico State Univ. Agr. Expt. Sta. Special Rept. #35. p. 218.

Thyr, B. D., D. K. Barnes, F. I. Frosheiser, O. J. Hunt, R. N. Peaden, and B. J. Hartman. 1979. Registration of MSE<sub>6</sub> SN<sub>3</sub> W<sub>3</sub> and MSF<sub>6</sub> SN<sub>3</sub> W<sub>3</sub> alfalfa germplasm. Crop Sci. 19:417.

#### Raleigh, North Carolina

Burns, J. C. and D. S. Chamblee. 1979. Chapter 2. Adaptation. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI 20:9-30.

Burns, J. C. and W. A. Cope. Rate of in vitro dry matter disappearance (IVDMD) of three crownvetch clones. Clover and special purpose legumes research. Research Progress Rept. 11:60-63.

Mueller, J. P., W. M. Lewis, J. V. Baird, J. A. Phillips, D. S. Chamblee, R. E. Welty, and W. V. Campbell. 1979. Forage crop production, alfalfa. Forage Memo No. 2, North Carolina Agr. Ext. Serv. 8 p.

Welty, R. E. 1979. Sclerotinia crown and stem rot. In J. H. Graham, F. I. Frosheiser, D. L. Stuteville, and D. C. Erwin (eds.) A compendium of alfalfa diseases. Amer. Phytopathol. Soc., St. Paul, MN. p. 33-34.

Welty, R. E. and H. B. Collins. 1979. Loss of viability of spores of Colletotrichum trifolii produced on lima bean agar. Plant Dis. Rept. 63:486-489.

Welty, R. E. and J. P. Mueller. 1979. Occurrence of a highly virulent isolate of Colletotrichum trifolii in North Carolina. Plant Dis. Reprtr. 63:666-670.

Welty, R. E. and J. P. Mueller. 1979. Occurrence of a highly virulent isolate of Colletotrichum trifolii on alfalfa in North Carolina. Phytopathology 69:537.

#### Mandan, North Dakota

Krupinsky, J. M. and E. L. Sharp. 1979. Reselection for improved resistance of wheat to stripe rust. Phytopathology 69:400-404.

#### Stillwater, Oklahoma

Whitney, R. W., R. M. Ahring, and C. M. Taliaferro. 1979. A mechanical harvester for chaffy seeded grasses. Transactions of the ASAE, 22(2):270-272.

Corvallis, Oregon

Hardison, J. R. 1978. Disease control in grass seed crops. Proc. Thirty-eighth Ann. Meeting, Oregon Seed Growers League. 38:15-16.

Philadelphia, Pennsylvania

Barford, R. A. and B. J. Sliwinski. 1979. Problems related to the use of sodium dodecylsulfate in HPLC. J. Chromatog. 171:445-447.

Barford, R. A., B. J. Sliwinski, and H. L. Rothbart. 1979. Interactions of proteins with bonded-phase ion exchangers. J. Chromatog. 185:393-403.

Barford, R. A., J. B. Sliwinski, and H. L. Rothbart. 1979. Observations on the rapid size-exclusion chromatography of proteins. Chromatographia 12:285-288.

University Park, Pennsylvania

Berg, C. C., R. R. Hill, Jr., R. C. Buckner, and R. F. Barnes. 1979. Forage production and quality of synthetics derived from Lolium X Festuca hybrids. Crop Sci. 19:89-93.

Berg, C. C., G. T. Webster, and P. P. Jauhar. 1979. Cytogenetics and genetics. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:93-109.

Bookbinder, M. G., K. T. Leath, F. L. Lukezic, and J. R. Bloom. 1979. Assessment of damage to field-grown alfalfa in Pennsylvania by the root-knot nematode Meloidogyne hapla. Plant Dis. Repr. 63:959-961.

Cornelius, P. L., W. C. Templeton, Jr., and T. H. Taylor. 1979. Curve fitting by regression on smoothed singular vectors. Biometrics 35:849-859.

De Vos, N. E., R. R. Hill, Jr., R. W. Hepler, E. J. Pell, and R. Craig. 1980. Inheritance of peroxyacetyl nitrate resistance in petunia. J. Amer. Soc. Hort. Sci. 105:155-160.

Gustine, D. L. 1979. Aliphatic nitro compounds in crownvetch: A review. Crop Sci. 19:197-203.

Hill, R. R., Jr. and R. A. Byers. 1979. Allocation of resources in selection for resistance to alfalfa blotch leafminer. Crop Sci. 19:253-257.

Hill, R. R., Jr., and K. T. Leath. 1979. Comparison of four methods of selection for resistance to Leptosphaerulina briosiana in alfalfa. Can. J. Genet. Cytol. 21:179-186.

Hurwitz, B., E. J. Pell, and R. T. Sherwood. 1979. Status of coumestrol and 4',7'-dihydroxyflavone in alfalfa foliage exposed to ozone. Phytopathology 69:810-813.



- Kendall, W. A., R. R. Hill, Jr., and J. S. Shenk. 1979. Inhibition by some allelochemicals of intake of individual meals by meadow voles. *Agron. J.* 71:613-616.
- Leath, K. T. 1979. Other root and crown rots. In J. H. Graham, F. I. Frosheiser, D. L. Stuteville, and D. C. Erwin (eds.) *A Compendium of Alfalfa Diseases*. Amer. Phytopath. Soc. p. 42-43.
- Leath, K. T. and C. F. Gross. 1979. Relationship between magnesium content of alfalfa and *Stemphylium* leafspot severity. *Plant Dis. Repr.* 63:741-743.
- Pfeffer, P. E., K. M. Valentine, B. G. Moyer, and D. L. Gustine. 1979. Assessment of 13 C-shift parameters in di- and tri-O-(3-nitropropanoyl) -D-glucopyranoses. *Carbohydr. Res.* 73:1-8.
- Schaaf, H. M. and R. R. Hill, Jr. 1979. Cros-fertility differentials in birdsfoot trefoil. *Crop Sci.* 19:451-454.
- Shenk, J. S. 1978. Instant analysis of forage and grain quality. *Crops and Soils* 30:7-8.
- Shenk, J. S., M. O. Westerhaus, and M. R. Hoover. 1979. Analysis of forages by infrared reflectance. *J. Dairy Sci.* 52:807-812.
- Shenk, J. S., M. O. Westerhaus, and M. R. Hoover. 1978. Infrared reflectance analysis of forages. *Proc. Internatl. Grass and Forage Harvesting Conf. Amer. Soc. Agr. Eng.* p. 242.
- Shenk, J. S., M. O. Westerhaus, M. R. Hoover, K. M. Mayberry, and H. G. Goering. 1978. Predicting forage quality by infrared reflectance spectroscopy. *Proc. 2nd Internatl. Grass Crop Drying Congr., Univ. of Saskatchewan, Saskatoon, Saskatchewan, Can.* p. 292-299.
- Templeton, W. C., Jr. 1979. Forage challenges in the Northeast. *Forage Handbook for Pennsylvania.* p. 1-9.
- Templeton, W. C., Jr. 1979. Forages for horses. *Proc. 3rd Ann. Kentucky Horseman's Shortcourse, Lexington, KY.* p. 81-94.
- Templeton, W. C., Jr. 1979. Pasture establishment and management for horses. *Proc. 3rd Ann. Kentucky Horseman's Shortcourse, Lexington, KY.* p. 14-31.
- Templeton, W. C., Jr., and J. S. Shenk. 1979. National infrared reflectance research project on forages. *Proc. 36th Southern Pasture and Forage Crop Improvement Conf., Beltsville, MD.* p. 61-63.
- Young, B. A., R. T. Sherwood, and E. C. Bashaw. 1979. Clear-pistil and thick-sectioning techniques for detecting aposporous apomixis in grasses. *Can. J. Bot.* 57:1668-1672.

Zeiders, K. E. 1979. A Septoria disease of reed canarygrass in Pennsylvania. Plant Dis. Repr. 63:796-800.

Clemson, South Carolina

Gibson, P. B., O. W. Barnett, and L. H. Huddleston. 1979. Virus infections reduce yield of Yuchi arrowleaf clover. Plant Dis. Repr. 63:297-300.

Knight, W. E., P. B. Gibson, W. A. Cope, J. D. Miller, and O. W. Barnett. 1978. Comparison of cyanogenesis in four sources of white clover plants. Crop Sci. 18:996-998.

College Station, Texas

Bovey, R. W., J. R. Baur, and E. C. Bashaw. 1979. Tolerance of kleingrass to herbicides. J. Range Manage. 32(5):337-339.

Young, B. A., R. T. Sherwood, and E. C. Bashaw. 1979. Cleared-pistil and thick-sectioning techniques for detecting aposporous apomixis in grasses. Can. J. Bot. 57:1668-1672.

Temple, Texas

Burson, B. L. 1979. Cytogenetics of Paspalum urvillei X P. intermedium and yellow-anthered P. dilatatum X P. paniculatum hybrids. Crop Sci. 19:534-538.

Prosser, Washington

Hartman, B. J., O. J. Hunt, J. H. Elgin, Jr., R. N. Peaden, and B. D. Thyr. 1979. Registration of Washington SNI alfalfa germplasm. (Reg. No. GP 96). Crop Sci. 19:416.

Hartman, B. J., O. J. Hunt, F. I. Frosheiser, S. A. Ostazeski, D. K. Barnes, R. N. Peaden, and B. D. Thyr. 1979. Registration of MNP-10 nondormant alfalfa germplasms. (Reg. Nos. GP 97 and 98). Crop Sci. 19:416.

Hartman, B. J., O. J. Hunt, R. N. Peaden, H. J. Jensen, B. D. Thyr, L. R. Faulkner, and G. D. Griffin. 1979. Registration of Nevada Synthetic YY nondormant alfalfa germplasm. (Reg. No. GP 99). Crop Sci. 19:416.

Nemec, S. and J. H. O'Bannon. 1979. Response of Citrus aurantium to Glomus etunicatus and G. Mosseae after soil treatment with selected fumigants. Plant and Soil 53:351-359.

O'Bannon, J. H. and H. W. Ford. 1979. Possible Radopholus similis biotypes reproducing and migrating on resistant rootstocks. Nematropica 9:104.

O'Bannon, J. H., R. N. Inserra, S. Nemec, and N. Vovlas. 1979. The influence of Glomus mosseae on Tylenchulus semipenetrans-infected and uninfected Citrus limon seedlings. J. Nematology 11:247-250.

O'Bannon, J. H. and S. Nemec. 1979. The response of Citrus limon seedlings to a symbiant Glomus etunicatus and a pathogen Radopholus similis. J. Nematology 11:270-275.

O'Bannon, J. H. and A. C. Tarjan. 1979. Management of Radopholus similis infecting citrus with DBCP or Phenamiphos. Plant Dis. Repr. 63:456-460.

Rincker, C. M. 1979. Alfalfa seed production in the Pacific Northwest. Proc. 25th Ann. Farm Seed Conf. Amer. Seed Trade Assoc.

Rincker, C. M. 1979. Stored seed survive. Agr. Res. 27(10):16.

Rincker, C. M. and J. D. Maguire. 1979. Effect of seed storage on germination and forage production of seven grass cultivars. Crop Sci. 19:857-860.

Taylor, N. L., R. G. May, A. M. Decker, C. M. Rincker, and C. S. Garrison. 1979. Genetic stability of 'Kenland' red clover during seed multiplication. Crop Sci. 19:429-434.

Thyr, B. D., D. K. Barnes, F. I. Frosheiser, O. J. Hunt, R. N. Peaden, and B. J. Hartman. 1979. Registration of MSE<sub>6</sub>, SN<sub>3</sub>, W<sub>3</sub> and MSE<sub>6</sub>, SN<sub>3</sub>, W<sub>3</sub> alfalfa germplasm. (Reg. Nos. GP 100 and 101). Crop Sci. 19:417.

#### Madison, Wisconsin

Beach, K. H. and R. R. Smith. 1979. Plant regeneration from callus of red and crimson clover. Plt. Sci. Let. 16:231-237.

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## National Research Program 20110

### IMPROVED VEGETATION AND MANAGEMENT PRACTICES FOR RANGE

This National Research Program involves research to develop new and improved technology to increase productivity from improved vegetation and management practices for range; to conserve, protect, and improve our Nation's range resources; and to enhance the multiple use of those resources. A multi-disciplinary team approach of both Federal and State researchers is dedicated to this effort.

NPS Contact: G. E. Carlson

Technological Objective 1: Acquire, describe, and evaluate new germplasm; and develop and test improved cultivars of grasses, legumes, shrubs, and forbs with increased ease of establishment, productivity, forage quality, persistence, improved seed qualities and tolerance to grazing, and with reduced losses from antiquity constituents, pests, and environmental hazards.

#### Research Locations:

Tucson, Arizona  
Fort Collins, Colorado  
Dubois, Idaho  
Las Cruces, New Mexico  
Mandan, North Dakota  
Woodward, Oklahoma  
Burns, Oregon  
Logan, Utah  
Cheyenne, Wyoming

#### Examples of Recent Progress:

Importance of seed weight on early seedling vigor of cicer milkvetch determined - Fort Collins, Colorado. The lack of association of seed weight with important growth analysis traits suggests that certain seedling vigor characters are entirely independent. The initial advantage of high seed weight progenies, however, tended to be maintained in the early phases of seedling development. Thus, with populations selected for high seed weight, additional progress in improving seedling vigor might be achieved through selection for relative leaf area expansion rate, net assimilation rate, or perhaps other traits.

More drought-tolerant cicer milkvetch germplasm pools developed - Fort Collins, Colorado. One pool was from plants selected for persistence at the Central Plains Experimental Range (30 cm annual precipitation) and the second



pool was from plants selected for persistence at the Central Great Plains Research Station (40 cm annual precipitation). Majority of plants in both pools trace to PI 66 515 which was introduced from the Botanical Garden, Stockholm, Sweden in 1926. The original source of the introduction is not known. Seed of this introduction was distributed widely in the Great Plains and Western States from 1929 to 1935. These pools will serve as source material for the development of more drought-tolerant cultivars of cicer milkvetch.

Development of germplasm pool of cicer milkvetch with earlier initiation of spring growth and more rapid recovery after harvest - Fort Collins, Colorado. When harvested for hay, cicer milkvetch does not yield as well as the more commonly grown forage legumes. The lower yield can be attributed to later initiation of spring growth and slower recovery after harvest. Parent lines of the pool trace to breeding populations developed for more rapid seedling emergence and for high seed weight. This pool will serve as source material for the development of higher yielding cultivars of cicer milkvetch.

Components of blue grama seed yield quantified - Fort Collins, Colorado. A cooperative study (Colorado State University, Soil Conservation Service, and SEA-Agricultural Research) indicated that seed size is a genetic characteristic of blue grama clones. Percentage seed set was negatively associated with seed size, but the low correlation coefficient ( $r = -0.17^{**}$ ) indicated that many plants had both large seeds and high seed set. The principal advantage of large seeds is an increased emergence from deep plantings. A twofold difference in seed size resulted in a fourfold difference in emergence from a depth of 4 cm, where soil moisture conditions for germination are generally more favorable than at shallower depths. Analysis of all components of seed yield indicated that selection could be made for large seeds as well as high seed yields. One cycle of selection for large seeds has been completed in this cooperative study.

Late seed harvest of *Kochia p.* is best - Burns, Oregon. Germination of both the grey and green forms was highest from seed collected on October 10. This information will be helpful in establishing new seedlings as seed of highest quality is essential for increasing establishment of this species whose seed quality diminishes rapidly in storage.

Floral nitrogen - a significant N compartment in N cycling - Burns, Oregon. In crested wheatgrass, yield of N in the floral organs ranged from about 1 to 3 kg/ha and in 1 year accounted for over half of the N lost from the herbage in a 5-week period following anthesis. This information will be useful to modelers attempting to synthesize the N cycle in plants, as this N compartment has not been previously estimated.

A taxonomic realignment of *Agropyron*, *Elymus*, and *Sitanion* is suggested by genomic relationships - Logan, Utah. *Agropyron* (wheatgrass), *Elymus* (wildrye), and *Sitanion* (squirreltail) are notorious for their taxonomic inconsistencies. Closely related species are often included in different genera, while distantly related species may be found in the same genus. Studies of chromosome pairing in more than 100 interspecific and intergeneric hybrids

(genome analysis) at Logan, Utah, over the past 15 years have made it possible to group species according to biological relationships. The realigned genera include: (1) Agropyron (crested wheatgrasses only), (2) Elymus (all self-fertilizing species of Agropyron, Elymus, and Sitanion), (3) Leymus (cross-pollinating species of Elymus), and (4) Elytrigia (cross-pollinating species of Agropyron, except the crested wheatgrasses). A taxonomic system that reflects relationships will ultimately benefit all users, although a short-term inconvenience will result from changes in nomenclature.

A three-species amphiploid hybrid shows promise as a new forage grass - Logan, Utah. Most colchicine-induced amphiploids exhibit reduced vegetative vigor compared to their F<sub>1</sub> counterparts. However, an amphiploid of Agropyron repens (quackgrass) X A. curvifolium (a spanish endemic) is more vigorous than its F<sub>1</sub> hybrid. An even further increase in vigor is achieved when the A. repens-A. curvifolium amphiploid is hybridized with an amphiploid of A. repens X A. desertorum (crested wheatgrass). Fertility of the three-species amphiploid hybrid is unacceptable, but that deficiency can probably be overcome by selection. This amphiploid population is now in the hands of the grass breeder at Logan.

A root-proliferating alfalfa synthetic developed with potential for range-lands - Logan, Utah. A 14,500 plant alfalfa source nursery was used in selecting germplasm adapted to semiarid environments. Each of the 250 parental plants used in forming the new synthetic were able to spread 42 inches or more in 3 years of growth by means of lateral root development. This unique characteristic will permit the alfalfa to spread into favorable niches in rangeland seedings and to grow in close association with companion grass species. Seed of the new synthetic will be increased in 1980 for advanced testing of its drought tolerance, forage and seed yield, and other agronomic traits.

Crested wheatgrass hybrid looks promising - Logan, Utah. Breeding lines of crested wheatgrass, obtained by hybridizing induced-tetraploid Agropyron cristatum with natural tetraploid A. desertorum, have excelled in preliminary evaluation trials. The hybrid derivatives were superior to other crested wheatgrass varieties in seedling vigor and stand establishment in tests at Dubois, Idaho, and have demonstrated excellent productivity under semiarid conditions in Colorado. Clonal lines, selected from a large breeding population on the basis of extensive progeny tests, are being combined in crossing schemes to produce experimental varieties. These varieties are expected to make a major contribution to the improvement of crested wheatgrass on western rangelands.

Search for reliable drought screening procedures - Logan, Utah. Seedling drought resistance is an essential characteristic for semiarid range forages as well as many other agronomically important species. Many techniques have been proposed for screening breeding lines for enhanced seedling drought resistance. However, the few procedures that have been examined within plant improvement programs have not proven reliable. Work in progress will provide definitive information concerning the applicability of various screening procedures for detecting breeding lines with superior seedling drought

resistance. Results from a wide range of laboratory and greenhouse screening procedures will be compared with results from droughty field sites. This evaluation will provide direction for future plant improvement work involving seedling resistance to drought.

Technological Objective 2: Develop range improvement practices for increasing productivity of rangeland.

Research Locations:

Tucson, Arizona  
Fort Collins, Colorado  
Dubois, Idaho  
Miles City, Montana  
Reno, Nevada  
Las Cruces, New Mexico  
Mandan, North Dakota  
Woodward, Oklahoma  
Burns, Oregon  
Temple, Texas  
Logan, Utah  
Cheyenne, Wyoming

Examples of Recent Progress:

Kochia prostrata found to be adapted to Arizona rangesites - Tucson, Arizona. Kochia prostrata, an introduced forage shrub from the Middle East, was established by transplanting and direct seeding on five of six sites in northern Arizona pinyon-juniper ranges. It is well adapted and rapidly spreading by natural seeding at these sites. This shrub could be used to revegetate depleted or disturbed rangelands by establishing it on portions of the more favorable sites and then allowing it to spread naturally. This information is important since it indicates a successful method of restoring rangelands which would require minimal funds, time, and energy, along with little soil disturbance.

Comoro sandy loam deficient in boron, phosphorus and molybdenum - Tucson, Arizona. Growth of Lehmann lovegrass growing on comoro sandy-loam in pots in the greenhouse was increased by the addition of boron, phosphorus and molybdenum but not zinc.

Afgan blue panic, Atherstone lovegrass and A-84 boer lovegrass most persistent on southern Arizona rangesites - Tucson, Arizona. Evaluations of a 10-year-old reseeding effort show that blue panic (Afgan) is the most adaptable species for reseeding on a sandy-loam creosotebush site. Atherstone lovegrass and boer lovegrass (A-84) are both persistent and produce high herbage yields on gravelly-sandy-clay-loam mixed brush sites. None of these species or cultivars is currently on the recommended reseeding list. Their addition to the list will provide a real benefit for land management agencies and private individuals seeking to restore semidesert grasslands.



Transplanting grasses successful in southern Arizona - Tucson, Arizona. Transplant survival of perennial grasses planted in the summer was greater for 9-week-old plants than for 7- or 5-week old seedlings. This procedure can be used to revegetate critical areas with little disturbance of the soil.

Absciscic acid applied to soil increases growth of greenhouse-grown grasses - Tucson, Arizona. Absciscic acid (ABA) when soil applied stimulated transplant growth of warm season grasses in a glasshouse. The proper timing and application rate would decrease the overall cost of growing grasses and may possibly increase survival of transplants after field planting.

Need for saving and replacing topsoil on coal strip mines demonstrated - Fort Collins, Colorado. Current regulations require that strip mine areas be reclaimed with an effective and permanent revegetation cover. A field experiment determined that the amount of vegetative cover established increased as the replaced topsoil depth was increased from 0 to 18 inches. In a greenhouse study, herbage production and root growth increased with depth of topsoil. Thus, replacing as much topsoil on the mine spoil as possible is necessary to obtain maximum cover and growth.

Quadratic response surfaces aid in comparing and interpreting germination of forage and weed species - Reno, Nevada. Quadratic response surfaces have been developed as a statistical tool to analyze germination responses of plant species to constant and alternating temperatures. These surfaces are composed of a family of curves, one for each night temperature depicting germination over a series of alternating day temperatures. These response surfaces are used to estimate percent germination with confidence limits. A number of germination parameters such as limiting temperatures and percentiles can be generated from the response surfaces to aid in interpretation. Quadratic responsive surfaces have been developed for numerous forage and competing weed species that are seeded or occur on semi-arid rangelands. Also, clonal material is being evaluated with response surface analyses for forage grass breeding programs. Comparisons among these response surfaces provide a valuable tool in selecting plant material for revegetating degraded rangelands or rangelands disturbed in mining operations.

Herbicides for brush control evaluated - Las Cruces, New Mexico. A number of herbicides were aerially applied to 5 ha plots 1977-79. The plots infested with honey mesquite treated with 0.5, 1.0, and 1.7 kg/ha active ingredient of tebuthiuron pellets in 1977 had plant kills of 23%, 60%, and 93%, respectively. Treatments greater than about 1.3 kg/ha of tebuthiuron severely depressed the residual stands of desirable mesa dropseed on this sandy site. It appears that 1.0-1.1 kg/ha of tebuthiuron would be an effective control on areas infested with honey mesquite. The plots infested with creosotebush and tarbush treated with 0.2, 0.6, and 1.3 kg/ha of tebuthiuron pellets in 1977 had plant kills of 62 and 76%, 95 and 98%, and 91 and 98% of creosotebush and tarbush, respectively. These data suggest that 0.2 - 0.3 kg/ha active ingredient of tebuthiuron pellets would be effective for controlling creosotebush and tarbush.

Carbon dioxide exchange in Yucca - Las Cruces, New Mexico. Intensive measurements of total CO<sub>2</sub> gains (photosynthesis) and CO<sub>2</sub> losses (root and leaf respiration) of Yucca elata showed that leaf photosynthesis and respiration, and root respiration rates are primarily dictated by temperature. Root



respiration was not found to be influenced by leaf photosynthesis as has been shown in other plant species in the literature. This anomalous response is thought to occur because of the large tap root possessed by this species, which is the site of photosynthate accumulation. Photosynthesis was shown to occur only in the presence of light and supports the hypothesis that this plant is a  $C_3$  plant rather than a CAM (Crassulacean Acid Metabolic pathway) plant as was previously thought in the literature.

The binary search for accuracy in plant symbols - Las Cruces, New Mexico.

The transfer of data from field sheets to computer files always involves the risk of errors being made in plant symbols or other identifying codes. If a master list of symbols or codes is incorporated into the software programs used for data entry on CRT computer terminals, the risk of making errors can be substantially reduced. This is done by utilizing the highly time-efficient binary search to compare each entered symbol or code with the master list. Detection of errors before the data are transferred to computer files saves much time which would otherwise be spent in retrieving and correcting files.

Response of mesquite dunelands to applications of 2,4,5-T - Las Cruces, New Mexico. Applications of 2,4,5-T to selectively control mesquite on dunelands resulted in grass and forb production of 985, 665, and 576 kg/ha in the first three seasons following treatment, respectively. Production on a non-treated area was 343, 156, and 259 kg/ha in the three seasons, respectively. Perennial grass production was three- to eight-fold greater on the treated area than on the non-treated area. Preliminary results of studies of small mammals, birds, insects, and soil micro-organisms indicate that treatments had a minimal impact on populations.

Hydrology of arid ranges - Las Cruces, New Mexico. Design of criteria for water ponding dikes was determined. Ponding water at a depth of 7.5 cm provides adequate water to wet a silty loam soil profile to 1.2 meters while water ponded at 15 cm wets the soil profile to a depth greater than 2.7 meters. Utilizing a diking system for ponding runoff water from an upslope barren area native grass production was increased from 2,635 to 4,871 kg/ha. Three conclusions from infiltrometer tests on creosotebush infested rangelands were noted: (1) bare soil plots had the least infiltration and the most runoff, (2) creosotebush plots had the greatest infiltration and the least runoff, and (3) grassed plots had greater infiltration than bare soil plots but less infiltration than creosotebush plots.

Moist soils and early fall burning most damaging to Idaho fescue - Burns, Oregon. Controlled burns of individual plants with before and after water treatment revealed that burning in August with soil moisture present before or after inflicted more damage to Idaho fescue than later burning or when soils were dry. This information will be helpful in selecting times to apply prescribed burns to rangelands so as to minimize herbaceous plant damage.

Pregerminated grass seeds improve seeding success - Temple, Texas. Pre-germinated grass seeds improve grass seeding success. The soil surrounding grass seeds planted by conventional methods to improve pastures or rangeland often dries out quickly, causing poor stands and sometimes total failure to establish stands of desired grasses. Seeds which were germinated before placement in moist soil produced satisfactory stands of grass in spite of drying conditions which caused failure of conventionally seeded grass seed.

Evaluation of new range forage germplasm expanded - Logan, Utah. Cooperative efforts of SEA-AR and university scientists, land management agencies, and ranchers are expanding throughout the Intermountain region. New study sites have been selected and new plantings made to more thoroughly evaluate newly developed and improved selections of range plants. Screening of hybrid lines by grazing livestock is underway. In the near future, seed will be available to begin grazing management studies in the Agropyron repens X A. spicatum hybrid. This evaluation program provides practical application for range forage breeding programs and will provide direction in developing new plants for rangeland and pasture improvement.

Technological Objective 3: Develop grazing (forage-livestock) management systems which convert range forage more efficiently to animal products and are consistent with improvement, conservation, and multiple use of range ecosystems.

Research Locations:

Fort Collins, Colorado  
Dubois, Idaho  
Miles City, Montana  
Reno, Nevada  
Las Cruces, New Mexico  
Mandan, North Dakota  
Woodward, Oklahoma  
Burns, Oregon  
Cheyenne, Wyoming

Identification of soil-surface types and their characteristic microsites help to explain trends in range condition under cattle grazing - Reno, Nevada. Different kinds of surface microsites occur on the four soil-surface types identified on grazing allotments in Nevada. In the ungrazed and untrampled condition some microsites are more favorable for germination and emergence of native grasses, forbs and shrubs than are others. The proportion of kinds of microsites, therefore, determines the species composition of emerged seedlings and theoretically the species composition of established plants. Cattle trampling can change the soil-surface morphology and alter the kinds of microsites available for seedling emergence. For example, a decrease in microsites favorable for the emergence of desirable species would decrease the composition of these species. The corresponding increase in microsites favorable for undesirable species would increase the composition of these species and results in a downward trend in range condition. Proper

grazing management (season and intensity) should include a non-use period of sufficient time to allow for the reformation of microsites favored by desirable species.

Electronic weighing of livestock - Las Cruces, New Mexico. Animal weights, identification number, subdermal body temperature, date and time can be recorded on paper and/or cassette tape in a matter of seconds. The electronic system can operate unattended for extended periods in an automatic mode in remote locations. Labor requirements and animal stress are reduced compared to conventional mechanical weighing. A 30-minute motion picture covering this research was produced by Los Alamos Scientific Laboratory during 1979. Electronic I.D. Missing Link was selected to receive a CINE Golden Eagle Award from the Council in International Nontheatrical Events and will represent the United States of America in international motion picture events abroad.

Factors controlling cattle distribution on range defined - Cheyenne, Wyoming. Distance to water, slope, and range site were the primary factors determining where cows, calves, and yearling steers grazed on southern Wyoming foothill range. Radio-telemetry gear and daily observations showed that cattle do 83% of their grazing within 600 yards of water, and very seldom graze slopes steeper than 13%. Cattle also preferred loamy, wet, or subirrigated range sites, even though these sites made up only about 30% of the area available for grazing. Observations indicated 65% of the area sustained 83% of the grazing pressure, indicating that public and private land managers must consider slope, site, and distance to water, not just total area, in determining the number of livestock and game animals which can be supported on a range area without damaging the plant and soil resources.



## P U B L I C A T I O N S

### Tucson, Arizona

Johnsen, T. N., Jr., and J. W. Elson. 1979. Sixty years of change on a central Arizona grassland-juniper woodland ecotone. USDA-SEA--ARM, Western Ser. No. 7. 28 p.

### Fort Collins, Colorado

Hassanyar, A. S., and A. M. Wilson. 1979. Tolerance of desiccation in germinating seeds of crested wheatgrass and Russian wildrye. Agron. J. 71:783-786.

Laycock, W. A. 1979. Factors affecting choice of management strategies within the sagebrush ecosystem. Sagebrush Ecosystem Symposium, Utah State Univ., Logan, April 1978. p. 230-236.

Laycock, W. A. 1979. Introduction. In Norman R. French (ed.) Perspectives in Grassland Ecology, Results and Applications of the US/IBP Grassland Biome Study. Ecological Studies 32:1-2. Springer-Verlag, New York.

Laycock, W. A. 1979. Management of sagebrush. Rangelands 1:207-210.

Mcinnies, W. J. 1979. Dryland grasses for turf? Proc. 25th Annual Rocky Mountain Regional Turfgrass Conf. Extension Service, Colorado State University. p. 5-14.

Rice, I. G. 1979. Optimum temperature of drinking water for Hereford heifers on rangeland. Ph. D. Dissertation, Dept. of Range Science, Colorado State University. 64 p.

Townsend, C. E. 1979. Associations among seed weight, seedling emergence, and planting depth in cicer milkvetch. Agron. J. 71:410-414.

Townsend, C. E. 1979. Breeding cicer milkvetch for improved seedling emergence. Crop Sci. 19:613-616.

Townsend, C. E. 1979. Registration of C-4 and C-5 cicer milkvetch germplasm. Crop Sci. 19:298.

Townsend, C. E. 1979. Registration of C-9 cicer milkvetch germplasm. Crop Sci. 19:934.

Townsend, C. E., and G. O. Hinze. 1979. Registration of C-7 and C-8 cicer milkvetch germplasm. Crop Sci. 19:934.



Townsend, C. E., E. E. Remmenga, C. L. Dewald, R. L. Ditterline, B. A. Melton, and S. Smoliak. 1979. Evaluation of seedling emergence in cicer milkvetch by linear regression. Crop Sci. 19:694-697.

Townsend, C. E., G. A. Rogler, A. C. Wilton, and R. J. Lorenz. 1979. Registration of C-6 alfalfa germplasm. Crop Sci. 19:298.

Wilson, A. M., and D. D. Briske. 1979. Seminal and adventitious root growth of blue grama seedlings on the Central Plains. J. Range Manage. 32:209-213.

#### Duboise, Idaho

Murray, R. B., H. F. Mayland, and P. J. Van Soest. 1979. Seasonal changes in nutritional quality of Agropyron desertorum compared with six other semi-arid grasses. In J. R. Goodin and N. K. Northington (eds.) Proc. Internatl. Arid Lands Conf. on Plant Resources. p. 538-549. Texas Tech. Univ., Lubbock.

#### Reno, Nevada

Eckert, R. E., Jr. 1979. Renovation of sparse stands of crested wheatgrass. J. Range Manage. 32(4):332-336.

Eckert, R. E., Jr., M. K. Wood, W. H. Blackburn, and F. F. Peterson. 1979. Impacts of off-road vehicles on infiltration and sediment production of two desert soils. J. Range Manage. 32:394-397.

Eckert, R. E., Jr., M. K. Wood, W. H. Blackburn, F. F. Peterson, J. L. Stephens, and M. S. Meurisse. 1979. Effects of surface-soil morphology on improvement and management of arid and semi-arid rangelands. Proc. of the First Internatl. Rangeland Congress. Denver, CO. p. 299-302.

Jensen, E. H., V. R. Bohmon, T. P. Ringkob, M. Stevenson, and R. E. Eckert, Jr. 1979. Forage finishing of beef cattle. Symposium Proc. Management of Intermountain meadows. R. J. 141. Second Edition. Univ. of Wyoming Agr. Expt. Sta. and Colorado State Univ. Mountain Meadow Research Center.

McCormick, J., J. A. Young, and W. Burkhardt. 1979. Making Hay. Rangelands 1(5):203-206.

Roundy, B., R. C. Eckert, Jr., and R. A. Evans. 1979. Soil moisture and grass growth in northern Nevada in a drought year. Rangelands 1(3):112-113.

Spencer, J., V. Rashelof, and J. A. Young. 1979. Safety modification for operation and transportation of the rangeland drill. J. Range Manage. 32(5):406-407. Technical note.

Stephens, J. L., R. E. Eckert, Jr., and F. F. Peterson. 1979. Properties, occurrence, and management of soils with vesicular surface horizons. Effects of disturbance by natural and simulated cattle trampling on seedling emergence from different soil surface types. Final Rpt. Contract YA-512-CT7-14. Between the Bureau of Land Management and the Nevada Agr. Expt. Sta., Reno, NV.

Young, J. A., R. E. Eckert, Jr., and R. A. Evans. 1979. Historical perspectives regarding the sagebrush ecosystem. Proc. Symposium-Sagebrush Ecosystem, Utah State Univ., Logan, UT. p. 1-13.

Young, J. A. and R. A. Evans. 1978. Germination requirements as determinants of species composition of Artemisia rangeland communities. Proc. of the First Internatl. Rangeland Congress. Denver, CO. p. 363-370.

#### Las Cruces, New Mexico

Barnett, C. R. 1979. Electronic identification missing link. Los Alamos Sci. Lab. Prod. No. Y-334. 16 mm color, 15 min. (Libr. Congr. Card No. L.C. 79-701109).

Herbel, C. H. 1979. Arid land seeder. 33rd Annual Rept. Vegetation Rehabilitation and Equipment Workshop, Casper, WY, Feb. 11-12, 1979. p. 7-9.

Herbel, C. H. 1979. Utilization of grass- and shrublands of the southwestern United States. In B. H. Walker (ed.) Management of Semi-Arid Ecosystems. Elsevier Sci. Publ. Co. p. 161-203.

Pearson, H. A., C. H. Herbel, and D. T. Pendleton. 1979. A tour of East German agriculture. Rangelands 1(1):9-11.

Smith, G. S., H. E. Kiesling, C. H. Herbel, E. E. Ray, P. Trujillo, R. Orcasberro, and J. S. Sivinski. 1980. Sewage solids as supplemental feed for ruminants grazing rangeland forage. Trans. Amer. Nuclear Soc. 34:336-339.

Smith, G. S., H. E. Kiesling, C. H. Herbel, and P. Trujillo. 1980. Evidence of copper, manganese, and zinc deficiency in beef cattle grazing semi-arid range in southern New Mexico. Proc. N. Mex. State Univ., Cattle Feeders Shortcourse. p. 17-22.

#### Mandan, North Dakota

Barker, R. E. 1979. Roots--25 years from Western Grass Breeders to Grass Breeders Work Planning Conference. Proc. 25th Grass Breeders Work Planning Conf. p. 17-18

Barker, R. E., J. D. Berdahl, and E. T. Jacobson. 1979. Vegetative collection of western wheatgrass and blue grama in the western Dakotas. Proc. 25th Grass Breeders Work Planning Conf. p. 11.

Townsend, C. E., G. A. Rogler, A. C. Wilton, and R. J. Lorenz. 1979. Registration of C-6 alfalfa. Agron. J. 19:298.

#### Woodward, Oklahoma

Dewald, C. L. and V. H. Louthan. 1979. Sequential development of shoot system components in eastern gamagrass. J. Range. Manage. 32(2):147-151.

Horn, G. W., P. L. Sims, and K. S. Lusby. 1979. Protein sparing effect of monensin fed to steers wintered on dormant, native range. Anim. Sci. Res. Rept. p. 93-95.

Townsend, C. E., E. E. Remmenga, C. L. Dewald, R. L. Ditterline, B. A. Melton, and S. Smoliak. 1979. Evaluation of seedling emergence in cicer milkvetch by linear regression. Crop Sci. 19:694-697.

#### Burns, Oregon

Britton, C. M. and F. A. Sneva. 1979. Effects of haying, and non-use on flood meadow vegetation. 1979 Progress Report . . Research in Range Management. Oregon Agr. Expt. Sta. Spec. Rept. 549. p. 5-7.

Britton, C. M. and F. A. Sneva. 1979. Effects of Tebuthiuron on a western juniper community. 1979 Progress Report . . Research in Beef Cattle Nutrition and Management. Oregon Agr. Expt. Sta. Spec. Rept. 534. p. 10-13.

Sneva, F. A. 1979. Cool, clear water-water-water. 1979 Progress Report . . Research in Range Management. Oregon Agr. Expt. Sta. Spec. Rept. 549. p. 1-4.

Sneva, F. A. 1979. Lithium toxicity in seedlings of three cool season grasses. J. Plant and Soil 53:219-224.

Sneva, F. A. 1979. Temperature-precipitation considerations in eastern Oregon. Oregon Agr. Expt. Sta. Spec. Rept. 537. 45 p.

Sneva, F. A. and F. B. Gomm. 1979. Time and rate of paraquat application for curing meadow vegetation for winter grazing. J. Agron. 71:634-638.

Waller, S. S., D. K. Schmidt, J. L. Stubbendieck, C. M. Britton, and F. A. Sneva. 1979. Effects of harvest date and drying procedures on germination of Kochia prostrata (L.) Schrad. 1979 Progress Report . . Research in Rangeland Management. Oregon Agr. Expt. Sta. Spec. Rept. 549. p. 8-10.

#### Logan, Utah

Acikgoz, E. and M. D. Rumbaugh. 1979. Variation in seed and seedling traits of common vetch (Vicia sativa L.). Can. J. Plant Sci. 59:511-513.

Asay, K. H. 1979. Breeding grasses for revegetation of surface mining spoils in western U.S. In M. K. Wali (ed.) Ecology and Coal Resource Development. Proc. Internatl. Congr. for Energy and the Ecosystem, June 12-16, 1978. p. 1007-1011. Univ. North Dakota, Grand Forks.

- Asay, K. H. 1979. Grasses for revegetation of surface mining areas in western U.S. Proc. Surface Coal Mining and Reclamation Coal Conf. and Expo. V., Lexington, KY. p. 23-25. McGraw-Hill, NY.
- Asay, K. H. and D. R. Dewey. 1979. Breeding potential of promising interspecific hybrids in Triticeae grasses. Proc. Grass Breeders' Work Planning Conf. 25:14.
- Asay, K. H. and D. R. Dewey. 1979. Bridging ploidy differences in crested wheatgrass with hexaploid X diploid hybrids. Crop Sci. 19:519-523.
- Asay, K. H., R. V. Frakes, and R. C. Buckner. 1979. Breeding and cultivars. In R. C. Buckner and L. P. Bush (eds.) Tall Fescue. Monograph. Amer. Soc. Agron., Madison, WI. 20:111-139.
- Asay, K. H. and D. A. Sleper. 1979. Registration of Missouri-96 tall fescue. Crop Sci. 19:563.
- Dewey, D. R. 1979. Cytogenetics, mode of pollination, and genome structure of Agropyron mutabile. Bot. Gaz. 140:216-222.
- Dewey, D. R. 1979. The Hordeum violaceum complex of Iran. Amer. J. Bot. 66:166-172.
- Francisco Perez-Trejo, D. D. Dwyer, and K. H. Asay. 1979. Forage yield, phenological development, and forage quality of an Agropyron repens X A. spicatum hybrid. J. Range Manage. 32:387-390.
- Gomm, F. B. 1979. The accumulation of NO<sub>3</sub> and NH<sub>4</sub> in reed canarygrass. Agron. J. 71:627-630.
- Gomm, F. B. 1979. Climate and agriculture of Malheur-Harney Basin, Oregon. Oregon Agr. Expt. Sta. Spec. Rept. 530. 23 p.
- Gomm, F. B. 1979. Grazing management on mountain meadows. Proc. Management of Intermountain Meadows Symp., Jackson, WY. Univ. Wyoming RJ 141. p. 147-163 (revised) June 7-9.
- Gomm, F. B. 1979. Herbage yield and nitrate concentration in meadow plants as affected by environmental variables. J. Range Manage. 32:359-364.
- Gomm, F. B. 1979. Irrigated pastures for range livestock. Oregon Agr. Expt. Sta. Bul. 635. 15 p.
- Johnson, D. A. 1979. Improvement of perennial herbaceous plants for drought-stressed western rangelands. In N. C. Turner and P. J. Kramer (eds.) Adaptation of Plants to Water and High Temperature Stress. Wiley-Interscience, NY.
- Johnson, D. A. (ed.). 1979. Special Management Needs of Alpine Ecosystems. Soc. for Range Manage. Symp. Series, Denver, CO.



Rumbaugh, M. D. 1979. N. E. Hansen's contributions to alfalfa breeding in North America. South Dakota Agr. Expt. Sta. Bul. 665. p. 1-11.

Rumbaugh, M. D. 1979. A very unusual vetch. Utah Sci. 40:40-41.

Rumbaugh, M. D. and M. W. Pedersen. 1979. Survival of alfalfa in five semiarid range seedings. J. Range Manage. 32:48-51.

Sneva, F. A., and F. B. Gomm. 1979. Time and rate of paraquat application for curing meadow vegetation for winter grazing. Agron. J. 71:634-638.

#### Cheyenne, Wyoming

Abdalla, O. M. 1979. Nutritional evaluation of shortgrass prairie ranges of southern Wyoming by beef cattle. Ph. D. Dissertation, Colorado State Univ. 146 p.

Clark, D. H., J. W. Waggoner, Jr., R. H. Hart, H. D. Radloff, G. E. Nelms, R. W. Rice, M. B. Marshall, J. A. Hager, M. Hamid, and O. M. Abdalla. 1979. Beef herd performance on crested wheatgrass plus native range vs. native range alone; a four-year summary. Proc. West. Sect. Amer. Soc. Anim. Sci. 30:146-149.

Hart, R. H., E. F. Balla, J. W. Waggoner, Jr., H. D. Radloff, and K. V. Clark. 1979. Grazing effects on western and crested wheatgrasses. Univ. Wyoming Coll. Agr. Prog. Rept. 10-79:19-20.

Hart, R. H., J. W. Waggoner, Jr., and H. D. Radloff. 1979. Beef cattle performance on grazing systems combining native range and improved pasture. Univ. Wyoming Coll. Agr. Prog. Rept. 10-79:23-24.

Hart, R. H., D. D. Walker, R. L. Lewis, and H. R. Haise. 1979. Factors affecting nitrogen response of forages on high-altitude wet meadows. Proc. Symp. Intermountain Meadow Manage. p. 87-106. Wyoming Agr. Expt. Sta. Res. Jour. 141, 2nd ed. 232 p.

Howard, G. S., and M. J. Samuel. 1979. Atlas of epidermal plant fragments ingested by grazing animals. USDA-SEA-AR Tech. Bul. 1582. 143 p.

Howard, G. S., and M. J. Samuel. 1979. The value of fresh-stripped topsoil as a source of useful plants for surface mine revegetation. J. Range Manage. 32:76-77.

Pinchak, W. E., M. A. Smith, and J. W. Waggoner, Jr. 1979. Influence of forage resource, topography, and available water on grazing behavior of cattle on southern Wyoming foothill range. Univ. Wyoming Coll. Agr. Prog. Rept. 10-79:21.

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National Research Program 20160

INTRODUCTION CLASSIFICATION, MAINTENANCE, EVALUATION,  
AND DOCUMENTATION OF PLANT GERMPLASM

Research is directed to provide breeders and other applied plant scientists with the genetic resources needed for improving crop plants in terms of their reaction to environmental stresses such as insect and disease pests, adverse weather, and moisture supplies, and in terms of compositional characteristics and nutritional factors. It also provides for a continuing evaluation of new plant resources that have the potential of becoming viable new crops which can provide raw materials needed for changing industrial and medical technologies or to meet national requirements for strategic materials.

NPS Contact: Quentin Jones

Technological Objective 1: Expanded collections and improved maintenance, evaluation, and distribution of plant germplasm as sources of useful genetic material to improve existing crops and developing new crops.

Research Locations:

Davis, California  
Indio, California  
Fort Collins, Colorado  
Washington, D.C.  
Miami, Florida  
Experiment, Georgia  
Savannah, Georgia  
Ames, Iowa  
Beltsville, Maryland  
Glenn Dale, Maryland  
Geneva, New York  
Mayaguez, Puerto Rico  
Pullman, Washington  
Sturgeon Bay, Wisconsin

Selected Examples of Recent Progress:

Germplasm holdings increased Fort Collins, CO . During 1979, 8,879 seed samples were added bringing the total seed lots in storage on December 31, 1979, to 109,038. Approximately 15,000 rice samples and 81,000 small grain samples, representing the Small Grains Cereals Collection, have been received but not catalogued. To more efficiently utilize the unfilled storage space, heat-sealed, foil-laminated, flexible, moisture-barrier packages are being used as storage containers.



Computerization eliminates errors and speeds up cataloging of germplasm samples - Ft. Collins, CO. A new, improved computer-assisted information system for inventory maintenance and control was developed and made operational. The new system, developed by GRIP, minimizes cataloging errors through the use of check digits, and generates computer-printed labels for seed containers and record cards which reduces transcription errors and processing time for seed samples.

Maximum safe moisture content for seeds stored at sub-freezing temperatures determined - Fort Collins, CO. Tests on 130 seed samples stored 1 year in LN<sub>2</sub> showed no damage to viability except for seedcoat cracking in one bean and one radish cultivar. Seeds of 19 tree and shrub species have been stored in LN<sub>2</sub> in cooperation with BLM and FS. Maximum seed moisture content for safe cooling to -196°C (LN<sub>2</sub>) has been determined for radish (15%); corn (18-20%); tomato (12-15%); cucumber (15-16%); cauliflower (13-14%); cabbage (12-13%); and carrot (10-14%).

Chromosomal aberrations observed in root tips at first mitosis eliminated with continued growth - Fort Collins, CO. The frequency of chromosomal aberrations observed at first mitosis in root tips of germinating artificially-aged barley seeds was correlated with loss of germinability. The frequency of aberrations was markedly reduced after 3 and 5 weeks of plant growth, at meiosis, and in root tips of germinating seeds produced by plants from aged seeds, which suggests that aberrations induced by aging are eliminated during plant growth and reproduction and are not transmitted to the next generation.

Studies of genetic and chromosome tester stocks in barley - Fort Collins, CO. Seventy genetic stocks of barley were grown and their characteristics recorded. Also, 187 stocks for marker genes located and/or associated with chromosome maps were increased. New accessions received included 25 stocks for genetic male sterility from Montana, 4 multiple marker stocks for chromosome 6 from Canada, and 8 balanced tertiary trisomics from Arizona. Seeds of 130 genetic stocks were distributed. Linkage mapping studies of chromosomes 1 and 4 found a gene for albino (a<sub>c</sub>2) to be located at the proximal segment, less than 30% of the short arm from the centromere. Four genes, f5 for chlorina 5, br for brachytic, fc for chlorina, and gs3 for glossy sheath and spike were found to be located at the more distal segment of the 1S.

New citrus developed for homeowners - Miami, Florida. The Mateira mandarin (P.I. 226760) was introduced as seed from Okinawa in 1955, and has been tested at the USDA's Subtropical Horticulture Research Unit, Miami, Florida, for 17 years. Its outstanding characteristics are high productivity of small, rich-flavored, tangerine-like fruits, and its resistance to cold and tolerance of alkaline soil conditions. It is recommended for trial as a general purpose ornamental with edible fruit to plant out-of-doors in any parts of the United States where citrus fruit is grown. Because of its compact growth habit it also deserves trial as a container-grown miniature citrus tree, for indoor and patio use in northern areas where it can be brought inside during winter months.

Planting area for coffee, Cacao, and sugarcane germplasm further expanded - Miami, FL. Ten repository areas were cleared to facilitate maintenance. Local records of 5000 germplasm introductions were entered in computer files.

Six new sources of resistance to anthracnose identified from watermelon introductions - Experiment, Georgia. Six new sources of anthracnose resistance were discovered when the entire collection of 901 watermelon Plant Introductions were screened for resistance in the field. These are P.I.'s 244019, 255136, 255137, 266015, 270563, and 295842.

Crabapple cultivar resistant to diseases Ames, Iowa. Crabapple cultivar 'Jackii' (PI 54083) has been reported to be resistant to scab, fire blight, and blotch. This flowering crabapple provides a year round display of excellent foliage, flowers, and fruits, and is highly recommended for landscape use in the North Central Region.

Plant Introduction documentation computerized - Beltsville, MD. Crop germplasm totaling 5,527 items was documented through use of a newly implemented computer program, and distributed to germplasm curators and scientists. The initial PI documentation provides the primary reference point for all material coming into the entire National Plant Germplasm System and hence this accomplishment is a major step forward in future computer linkage among the PI office, germplasm curators, and the user community.

Technological Objective 2: New and improved knowledge of the chemical, biological, and agronomic potentials of selected plant species as new crop sources of industrial oils, waxes, gums, fibers, of food and feed proteins, and licit and illicit narcotic drugs and other medicinals.

#### Research Locations:

Flagstaff, Arizona  
Savannah, Georgia  
Bloomington, Indiana  
Peoria, Illinois  
Ames, Iowa  
Rehovot, Israel  
Beltsville, Maryland  
Islamabad, Pakistan  
Philadelphia, Pennsylvania  
Mayaguez, Puerto Rico  
Chiang Mai, Thailand  
Ankara, Turkey  
Pullman, Washington

#### Selected Examples of Recent Progress:

Thebaine percent and capsule weight in *P. bracteatum* not affected by nitrate fertilization - Flagstaff, Arizona. Spring and fall applications of ammonium nitrate, ammonium sulphate, and ammonium phosphate at rates of 50, 100, and 150 lb of nitrogen equivalent per acre did not significantly affect the thebaine percent in the capsule material.

SUMMARY OF PLANT GERMPLASM  
INTRODUCTION AND USE  
1979

	<u>Introduced</u>	<u>To Users</u>
<u>Principal Centers:</u>		
Office of Plant Introduction, Beltsville, MD		
Foreign Exchange	5,527 <u>1/</u>	94,489
Domestic		1,219
National Seed Storage Laboratory, Fort Collins, CO		
Base Collection, Long-term	8,879	2,339
<u>Working (Active) Collections:</u>		
Regional Plant Introduction Station, Experiment, GA	319	12,689
Regional Plant Introduction Station, Ames, IA	850	12,000
Regional Plant Introduction Station, Geneva, NY	500	7,850
Regional Plant Introduction Station, Pullman, WA	1,128	17,188
Small Grains Collection, Beltsville, MD	1,588	157,089 <u>2/</u>

1/ 28,340 additional items received, some of which will eventually be assigned PI numbers.

2/ Of this number 69,111 were sent to domestic users and 87,978 to foreign countries. These foreign exchanges were handled by the Office of Plant Introduction in addition to the 94,489 exchanges listed above.



Brassica lines analyzed in cooperation with Oregon State University - NRRC, Peoria, Illinois. In the continuing program to develop rapeseed as a crop for the northwestern United States, 172 high erucic acid/low glucosinolate *Brassica* lines were analyzed in cooperation with Oregon State University. Consistent erucic contents of more than 55% were found along with low glucosinolate values.

Seed accessions computerized - NRRC, Peoria, Illinois. All essential data from the over 14,000 seed accessions have been entered onto computer disc storage. Included are inventory and source information and chemical data. Programs have been implemented to access the data.

*Trewia nudiflora* yields new alkaloids with potentially valuable biological activity - NRRC, Peoria, Illinois. A series of four new macrocyclic alkaloids, members of a group called maytansinoids, have been isolated from seeds of *Trewia nudiflora* and they are the first maytansinoids to be found in the plant family Euphorbiaceae. These new alkaloids have two kinds of biological activity which are potentially valuable: larvicidal activity towards the European corn borer and antitumor activity.

Yellow oleander seed yields potent larvicide - NRRC, Peoria, Illinois. As a part of a program of screening plants for pest control activity, extracts of yellow oleander (*Thevetia thevetioides*, plant family Apocyanaceae) were found to be a potent larvicide towards the European corn borer. Fractionation and characterization work has revealed that a toxic steroidal glycoside, neriifolin, is the constituent most lethal to these larvae. When added to the diet, it shows LD<sub>50</sub>=30 ppm.

Selenium protection factors - NRRC, Peoria, Illinois. For over 20 years, it has been recognized that flaxseed possesses unique properties in protecting livestock against the toxic effects of selenium compounds accumulated in forage plants. Two compounds responsible for this protective action have been characterized--linustatin and neolinustatin. These compounds are previously unknown cyanogenic glycosides derived from  $\beta$ -gentiobiose. This work was carried out in collaboration with South Dakota State University, where the compounds were isolated.

Potato slices for antitumor screening - NRRC, Peoria, Illinois. Potato slices can be infected with crown gall tumor, the only true tumor known to affect plants. A variety of plant-derived antileukemic agents inhibit the development of tumors in these infected potato slices. Preliminary results indicate a positive correlation with activity in murine leukemia, but negative results with extracts that show only cytotoxicity by the conventional screening procedures. These observations suggest that this potato slice technique has the potential for greatly facilitating screening of plant extracts for antitumor activity because of its speed, low cost, and low sample requirement. This work was carried out in collaboration with Bradley University.

Chemicals applied to poppy plants reduce harvestable alkaloids - ERRC, Philadelphia, Pennsylvania. Sodium sulfite, diethyldithiocarbamate, and Ethrel<sup>R</sup> modify the chemistry or physiology of the poppy plant, *Papaver somniferum*, to



greatly reduce the amount of morphine that can be obtained from the plant. Sodium sulfite and diethyldithiocarbamate inhibit enzyme systems necessary for alkaloid production; Ethrel promotes abscission of capsules from the stem and causes capsules to fall off or decay in place.

Plant population study with *Papaver bracteatum* completed - Pullman, Washington. Plant populations of 26,900 to 287,000 *P. bracteatum* plants per hectare were used in this 5-year study. The better yields of capsules and thebaine per unit area came from plant populations of 49,000 to 66,000 plants per hectare after the second year of production. The first 2 years the higher plant populations were the most productive. Thebaine yield estimates were in the 30 to 36 kg/ha range, or codeine equivalents of 20 to 23 kg/ha. Accessions with high first year thebaine continued to retain this relative position through the 5 years of the test.

New peanut variety from PI 355897 - Pullman, Washington. A new peanut variety named 'New Mexico Valencia C' was released as a selection from PI 355897.

Chile pepper PI 297474 of interest to breeders - Pullman, Washington. Chile pepper (*Capsicum annuum*) PI 297474 is of interest to plant breeders working to develop mechanical harvesting, since this introduction has brittle pedicels at maturity, thereby requiring little pressure to remove the pepper from the plant.

Technological Objective 3: Increased understanding of the taxonomic relationships, geographical and ecological distribution, and centers of diversity of crop plants and their wild relatives to promote the systematic assembly of germplasm for crop improvement.

#### Research Locations:

Beltsville, Maryland  
Washington, D.C.

#### Examples of Recent Progress:

Nickel accumulation by *Alyssum* - National Arboretum, Washington, D.C.

The hyperaccumulation of the heavy metal, nickel, by the genus *Alyssum* appears to be restricted to one section of the genus, section *Odontarrhena*. A species from Portugal, *Alyssum pintodasilvae*, has recently been described as new to science as a hyperaccumulator of nickel. Two other genera, *Bormuelleria* and *Peltaria* have been confirmed as being hyperaccumulators of nickel.

## P U B L I C A T I O N S

### Fort Collins, Colorado

Murata, M., E. Roos, and T. Tsuchiya. 1979. Relationship between loss of germinability and the occurrence of chromosomal aberrations in artificially aged seeds of barley. Barley Genetics Newsletter 9:65-67.

Roos, E. E. 1979. Storage behavior of pelleted, tableted, and taped lettuce seed. J. Am. Soc. Hort. Sci. 104:283-288.

Stanwood, P. C., and E. E. Roos. 1979. Seed storage of several horticultural species in liquid nitrogen (-196°C). Hort. Science 14:628-630.

### Washington, D.C.

Brooks, R. R., R. D. Reeves, R. S. Morrison, T. R. Dudley, and Y. Akman. 1979. Hyperaccumulation of Nickel by Alyssum Linnaeus (Cruciferae). Proc. Royal Soc. London, Sect. B, 203 (No. 1152): 387-403.

### Miami, Florida

Knight, R. J., Jr. 1977. Citrus and citrus relatives in the Miami germplasm collection. Proc. Int. Soc. Citriculture 2:608-609.

### Experiment, Georgia

Adamson, W. C., Long, F. L., and Bagby, M. O. 1979. Effect of nitrogen fertilization on yield, composition, and quality of kenaf. Agron. J. 71:1-14.

Sowell, G., Jr., and N. W. Schaad. 1979. Pseudomonas pseudoalcaligenes subsp. citrulli on watermelon: seed transmission and resistance of plant introductions. Plant Disease Reporter 63:437-441.

### Ames, Iowa

Bhella, H. S. 1979. Ten-year testing and evaluation reports for the North Central Regional Ornamental Plantings: 1965-75. USDA-SEA-AR Technical Research Report.

### Peoria, Illinois

Chang, S. P., and T. K. Miwa. 1979. Allyl esters of crambe-derived long-chain fatty acids and their polymers. J. Appl. Polym. Sci. 24:441-454.

Freedman, B., L. J. Nowak, W. F. Kwolek, E. C. Berry, and W. D. Guthrie. 1979. A bioassay for plant-derived pest control agents using the European corn borer. J. Econ. Entomol. 72:541-545.

Grove, M. D., G. F. Spencer, W. K. Rohwedder, N. Mandava, J. F. Worley, J. D. Warthen, G. L. Steffens, J. L. Flippen-Anderson, and J. C. Cook. 1979. Brassinolide: A plant growth-promoting steroid isolated from Brassica napus pollen. Nature 281:216-217.

Miwa, T. K., J. A. Rothfus, and E. Dimitroff. Extreme-pressure lubricant tests on jojoba and sperm whale oils. J. Am. Oil Chem. Soc. 56:765-770.

Princen, L. H. 1979. New crop developments for industrial oils. J. Am. Oil Chem. Soc. 56(9):845-48.

Smith, C. R., R. V. Madrigal, and R. D. Plattner. 1979. New conjugated hydroxy-dienoid fatty acids and acetotriglycerides from Securidaca longipedunculata seed oil. Biochim. Biophys. Acta 572:314-324.

Spencer, G. F., W. F. Kwolek, and L. H. Princen. 1979. A simple, graphic procedure for authentication of commercial fats and oils based on fatty acid compositions in codex standards. J. Am. Oil Chem. Soc. 56:972-73.

#### Beltsville, Maryland

Engelke, B. F., and P. G. Vincent. 1979. Thin layer chromatography combined with color spot test reactions for the preliminary identification of papaveraceous alkaloids. J. Assoc. Off. Anal. Chem. 62:538-544.

Calhoun, W., and J. M. Crane. 1979. Seed yields of meadowfoam as influenced by N, seeding rates, and soil-water table levels. Agron. Jour. 70:924-26.

Gunn, C. R. 1979. Systematic treatment of genus Vicia with notes about tribe Viciaeae (Fabaceae) in Mexico and Central America. USDA Tech. Bull. 1601, 41 pp.

Plowman, T. 1979. Botanical perspectives on Coca. J. Psychedelic Drugs 11:103-17.

Terrell, E. E., and W. P. Wergin. 1979. Scanning electron microscopy and energy dispersive X-ray analysis of leaf epidermis in Zizania (Gramineae). Scanning Electron Microscopy 3:81-88.

Tolbert, D. M., C. O. Qualset, S. K. Jain, and J. C. Craddock. 1979. A diversity analysis of a world collection of barley. Crop Science 19:789-94.

Vincent, P. G., and B. F. Engelke. 1979. High pressure liquid chromatography determination of the five major alkaloids in Papaver somniferum L. and thebaine in Papaver bracteatum Lindl. capsular tissue. J. Assoc. Off. Anal. Chem. 63:310-14.

Winters, H. F. 1979. 'Pink Lady' and 'Sleeping Beauty' Rose Mallow Hibiscus. HortScience 14(6):763-64.

#### Glenn Dale, Maryland

Waterworth, H. E., J. M. Kaper, and M. E. Tousignant. 1979. CARNA 5 the small cucumber mosaic virus-dependent replicating RNA, regulates disease expression. Science 204:845-47.

#### Pullman, Washington

Davis, A. M. 1979. Forage quality of prostrate Kochia compared with three browse species. Agronomy Journal 71:822-24.

NRP 20160 - LOCATIONS

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## National Research Program 20170

### PHYSIOLOGICAL AND BIOCHEMICAL TECHNOLOGY TO IMPROVE CROP PRODUCTION

National Research Program 20170 involves research elucidating the basic function of plants at the physiological and biochemical level. New data yielded by this research will establish advanced agricultural technology focused on field and horticultural crops. Among the major emphases of this National Research Program are photosynthetic efficiency and biological conversion of solar energy by plants; biological nitrogen fixation and utilization of nutrients; environmental stress damage to plants; and molecular biology to increase crop production efficiency.

NPS Contact: Gerald G. Still

Technological Objective 1: Improve biological conversion of solar energy for increased crop production by increasing the efficiency of photosynthesis, translocation, and associated metabolism.

#### Research Locations:

Athens, Georgia  
Peoria, Illinois  
Urbana, Illinois  
Beltsville, Maryland  
Ithaca, New York  
Raleigh, North Carolina  
Lubbock, Texas

#### Examples of Recent Progress:

Studies of three C<sub>4</sub> species of *Brachiania* and *Urochloa* for inter- and intracellular localization of the decarboxylating enzyme PEP carboxykinase - Athens, Georgia. Using enzymatically isolated mesophyll and bundle sheath protoplasts and differential centrifugation of the protoplast extracts, the enzyme was found to be predominantly localized in the cytoplasm of bundle sheath cells. In leaves of plants with C<sub>4</sub> photosynthesis, it was found that sulfur assimilation is initiated in bundle sheath cells, whereas carbon and nitrogen assimilation are initiated in mesophyll cells. The activation of sulfate by ATP sulfurylase in leaves of C<sub>4</sub> plants occurs in chloroplasts of bundle sheath cells and is brought about by two isozymes of approximately equal activities that account for 95-100 percent of the total leaf activity.

Photosynthesis and heat stress in plants - Peoria, Illinois. The serendipitous observation that brown sea kelp turns green on heating to 55 C may find practical implications for crop plants under heat and water stress. More important than the color change is the disruption of light energy transfer. The orange pigment of the diatom no longer contributes its absorbed light to green chlorophyll and to photosynthesis of the cell. Similarly, in the green algal species Chlorella pyrenoidosa, which serves as a model for crop plants, the light energy absorbed by chlorophyll b is no longer transferred to chlorophyll a and to photosynthesis.

Light harvesting caroteno-chlorophyll-protein complex isolated - Peoria, IL. By use of exceptionally mild conditions, an orange-colored caroteno-chlorophyll protein has been isolated from the diatom Pheodactylum tricornutum. The efficiency of light energy transfer from carotenoid pigments to chlorophyll a is nearly equivalent to that of the intact algal cell but is destroyed by sonication and detergents normally used in protein isolations. Ratios of pigments in this complex are carotene-chlorophyll, a-chlorophyll, b-chlorophyll, c-fucoxanthin-neofucoxanthin, 1:3:3:12:4. Light harvesting caroteno-proteins also occur in higher plants and may therefore also contribute to increased photosynthetic efficiency and yield of the crop plants through increased absorption of light.

Model light capture system - Peoria, Illinois. A system has been devised consisting of chlorophyll a and chlorophyll b adsorbed on a specific hydrophobic surface. Chlorophyll a and chlorophyll b adsorbed together show individual and additive light absorption characteristics, but, under certain conditions, only the red fluorescence of chlorophyll a. This means, as in the intact green leaf, light energy absorbed by chlorophyll b is transferred to chlorophyll a causing chlorophyll a only to emit fluorescent light. This pioneering experiment opens a new path for understanding how light energy is absorbed, transferred, and used in photosynthesis.

Photorespiration: A process which substantially reduces photosynthetic assimilation of atmospheric carbon dioxide with no apparent benefit to the plant - Urbana, Illinois. Photorespiration is a major limiting factor in the productivity of all major crops except corn, sorghum and sugar cane. Toward the elimination of photorespiration, plant strains have been created in which photorespiration has become a lethal characteristic. These plants die when grown in normal air and survive only under artificial conditions where photorespiration cannot function. Seeds of these genetically altered strains will not be mutagenized and the subsequent generations screened for survival ability in air. One expected class of survivors will grow because they no longer have photorespiration. In such plants, a 50 percent increase in the efficiency of converting sunlight energy into biomass production and seed yield will be realized.



Data for development of better herbicide utilization procedures - Urbana, Illinois. Approximately half of all commercially important pesticides are herbicides; more than half of these herbicides act by inhibiting photosynthesis and concomitantly causing plant death. Triazine herbicides (atrazine, simazine, metribuzin/sencor) are very important examples of these photosynthetic inhibitors. In the early 1970's, it was reported that weed biotypes were discovered that no longer responded to triazine herbicide treatment.

At present, there are approximately 15 species of weeds which have spontaneously appeared. Studying basic photosynthesis processes, a reason has now been formulated for the appearance of these weeds. It has been demonstrated that the site of action of the triazines (a protein serving as an electron carrier in chloroplast membranes) is modified so that the herbicides no longer bind, i.e., the resistant weed species essentially do not know that herbicides are present. The change in the herbicide binding site has been found in all of the newly discovered resistant weeds. A specific protein (only one out of more than 50) in the chloroplast membrane that is different in the resistant weeds has not been identified. Biochemical characterization of this protein is leading to a better understanding of potential problems of spread of resistance, as well as mechanisms of how this trait could be introduced into crop plants.

Research into the mechanisms of energy conversion and ATP formation significance - Urbana, Illinois. Severe inhibition of photosynthesis by chilling temperatures in thermophilic plants is not at the level of gas exchange of the leaf with the atmosphere. The intolerance of thermophilic crops to chilling night temperatures has a profound effect on the practice of agriculture. Chilling injury causes extensive losses; and since this delays growth in the spring, it is an important cause of unattained production potential. Because warm weather crops are excluded from cool regions, the farmer often must substitute a lower yielding, early maturing variety or an entirely different, less desirable crop. In warm regions, early planting which would avoid exposure of the crop to late summer drought, cannot be practiced because of the possibility of cool nights. Understanding the fundamental basis for the difference between chilling tolerance and chilling intolerance is an essential step toward the ultimate goal of reducing the constraints that chill sensitivity places on agriculture.

High rates of photosynthesis in leaves and isolated chloroplasts from plants adapted to short photosynthetic periods apparently due to increased RuBP carboxylase activity - Beltsville, Maryland. Soybean plants adapted to a short photosynthetic period fix more  $^{14}\text{CO}_2$  per mg dry weight per hour and



have higher rates of starch accumulation than plants adapted to a long photosynthetic period. Similarly, chloroplasts, isolated from long or short photosynthetic period adapted plants, reflect the same programming of photosynthesis and starch accumulation as measured in whole plants. Measurements of  $O_2$  evolution from isolated chloroplasts of long and short photosynthetic period adapted plants, show no difference in photosystem I and II activity. Therefore, the difference in photosynthetic rates between long and short photosynthetic period adapted plants is not in the electron transport processes. However, Ribulose-1-5-bisphosphate activity is up to 1.5 times higher in chloroplasts of short than long photosynthetic period adapted plants. The higher rates of photosynthesis in short photosynthetic period adapted plants may be a result of higher RuBP carboxylase activity.

Drought tolerance related to photosynthetic characteristics - Beltsville, Maryland. Improved drought tolerance in selected soybean genotypes is the result of higher rates of photosynthesis at low water potential. A decrease in the stomatal conductance always reduces light saturated photosynthesis in  $C_3$  species. However, reduced stomatal conductances in  $C_4$  species does not always lower their rates of photosynthesis.

Regulatory mechanisms, role and regulation of transport across the chloroplast envelope, and transport of sucrose across the plasmalemma of photosynthetically efficient and nonefficient plants - Raleigh, North Carolina. Photosynthesis by isolated chloroplasts of spinach and wheat was stimulated by low concentrations of exogenous inorganic phosphate and inhibited at higher concentrations. The ability of chloroplasts to utilize inorganic phosphate during photosynthesis was decreased by an increase in internal (stromal) pH. The results could be explained on the basis of pH-dependent changes in substrate affinity of certain photosynthetic enzymes. It was shown that external pH affected the chloroplast stromal pH, which suggests the potential for control of chloroplast photosynthesis in vivo by cytoplasmic parameters.

The control of photosynthetic end-product formation within the mesophyll cell was investigated. Isolated leaf protoplasts and cells of various species, including wheat, soybeans, and peanuts, assimilated  $^{14}CO_2$  at high rates in vitro but formed starch and sucrose at different rates. Mesophyll preparations from species known to accumulate high levels of leaf starch assimilated more  $^{14}C$  into starch and less into sucrose than did preparations from species which do not accumulate leaf starch. The results indicated that photosynthetic end-product formation is biochemically controlled within the mesophyll cell and that genetic (interspecific) variation exists in the control mechanism(s).

The sucrose formed during photosynthesis in vitro by isolated protoplasts of wheat, barley, and tobacco was transported across the plasma membrane and released to the medium. The mechanism of transport was shown to involve sucrose- $K^+$  cotransport. Inhibition of sucrose transport decreased photosynthetic sucrose formation and increased starch formation. The results provided direct support for the apoplastic model of translocation, which postulates transport of sucrose across the plasma membrane, and indicates that the medium represents a large "sink" for photosynthetic end-products during photosynthesis in vitro.

Technological Objective 2: Improve nitrogen fixation efficiency of bacteria-plant associations and develop nitrogen-fixing capabilities in crops lacking this capability in order to reduce energy requirements for crop production.

Research Locations:

Albany, California  
Gainesville, Florida  
Peoria, Illinois  
Beltsville, Maryland  
St. Paul, Minnesota  
Ithaca, New York  
Raleigh, North Carolina

Examples of Recent Progress:

New species of *Rhizobium* found on mesquite found to tolerate high salinity - Albany, CA. A new species of *Rhizobium* was found on mesquite plants. This species has a high salt tolerance, living at sodium chloride concentrations as high as 0.5 molar and at pH ranges of 4.5 to 8.5. Other *Rhizobium* species are now being screened for salt tolerance; however, the new species may facilitate nitrogen fixation by legumes in the semi-arid areas of the American West.

High cytokinin concentrations reportedly found in active root nodules - Albany, CA. Analytical procedures for cytokinins may help us to understand the relationships, if any, between plant hormone levels and nitrogen fixation. They may also provide insight into other metabolic processes of plants.

Complete lysimeter studies to identify interactions occurring between C<sub>4</sub> plants and rhizosphere microorganisms which promote their rate of growth - Gainesville, Florida. Environmental conditions supporting intense microbiological activity in the rhizosphere (optimum temperature and moisture suitable energy substrates) induced a modest increase in N<sub>2</sub> fixation (C<sub>2</sub>H<sub>2</sub> reduction). Under all environmental conditions studied, however, diazotroph numbers remained low relative to the total bacterial population, regardless of inoculation treatment. Their net input of fixed nitrogen was far below that required to support rapid plant growth. "Leaky" roots (as an energy source to drive the nitrogen fixation process in root-associated diazotrophs) may not be of great importance because we find that the diazotrophs use only a small portion of the energy substrate made available to them in soil. This is the case both when increased substrate is supplied by plant roots and also when various sugars and organic acids are added as amendments, and under various redox levels and moisture regimes.

Structure of an unusual rhizobial polysaccharide - Peoria, Illinois.

Structural characterizations were completed on the capsular polysaccharide (CPS) of the microsymbiont from nodules of Acacia decurrens. Methylation analyses of carboxyl-reduced and periodated-degraded CPS and of oligosaccharides from partial hydrolyzates revealed a complex structure. L-Rhamnose residues are the sole nonreducing end groups and are  $\alpha$ -linked to three different sites in the CPS. Only one of these residues becomes biologically 3-O-methylated as the culture ages. In Rhizobium japonicum CPS, progressive O-methylation of a nonreducing end group is thought to cover up the recognition site that binds with soybean lectin on root hairs. Characterization of oligosaccharide fragments of the CPS and methylation analyses revealed an underlying structure resembling that of R. japonicum CPS.

A new medium for differential growth of asymbiotic, acetylene-reducing rhizobia - Peoria, Illinois. A new agar medium was developed for selection of rhizobia that can display nitrogenase activity in the free-living state. In addition, differential antibiotic sensitivities and nitrogen requirements were found to occur naturally among the rhizobia tested. These characteristics should be useful in physiological studies of the organisms and in selection of genetic recombinants with desirable traits; e.g., enhanced nitrogen fixation efficiency and competitive surface recognition factors.

Physiological controls of associative nitrogen fixation in grasses - Beltsville, Maryland. The establishment and function of bacteria-grasses associations was investigated. Roots of native grasses and rice were found to support immediate nitrogenase activity without the previously reported period of zero activity lasting 8 to 16 hours by Brazilian grasses. The significance of this finding is that it provides compelling evidence that nitrogen fixation is associated with the roots of certain non-disturbed plants. This characteristic allows meaningful studies of the relationship between nitrogen fixation and the physiology and ecology of these grasses, and facilitates short-term studies to determine interactions concerning this project to evaluate the biological significance of nitrogen fixation in grass-bacteria associations.

Improved biological nitrogen fixation in peanut plants by managing insect parasites with Temik - Beltsville, Maryland. Four peanut cultivars treated with 0, 1.18, or 2.36 kg Temik 15 G/ha were evaluated for insect parasitism and several agronomic characteristics in a two-year study. Thrip numbers and thrip foliar injury were significantly reduced by Temik. Leafhopper foliar injury was significantly reduced by Temik. Fresh weights of tops, roots, and nodules and foliar nitrogen contents were significantly increased by Temik treatments. Pod yields were significantly higher in Temik-treated plots than in zero Temik plots.

The influence of host-plant and Rhizobium strains on dry matter and nitrogen accumulation by nodulated soybeans - Raleigh, North Carolina. The cvs Ransom and Davis achieved the same seed and nitrogen yield when nodulated by an efficient Rhizobium strain. High nitrogen fixation capability and



nitrogen remobilization during development are physiological traits associated with the yield potential of both cultivars. The capability of the Rhizobium strain regulates nitrogen fixation and nitrogen remobilization. Ransom allocated more photosynthate for support of nitrogen fixation during reproductive development than did Davis. This type of physiological information will be used to select soybean genotypes with enhanced nitrogen fixation and productivity.

Technological Objective 3: Develop new and improved cell and tissue culture technology for plant improvement through increased genetic diversity and rapid vegetative propagation.

Research Locations:

Albany, California  
Peoria, Illinois  
Beltsville, Maryland  
Madison, Wisconsin

Examples of Recent Progress:

Research to freeze tissue cultures which will still be viable and capable of differentiation after thawing - Albany, California. It was found that deep frozen samples should be thawed rapidly for greatest viability of tissue, and that it is important to wash out the cryoprotective agent(s) after thawing. Five species of callus culture--sugarcane, date palm, alfalfa, rice, and soybean--have been frozen to liquid nitrogen temperature and have grown after thawing. All of the frozen cultures differentiated to some extent and date palm cultures stored at liquid nitrogen temperature for 3 months produced whole plantlets. Sugarcane stored at -23 C produced a whole plant. Long term storage tests were initiated with date palm and rice. Other tissues including asparagus, grape, tomato, beans, grapefruit, cherry, apricot, peach, and coast redwood were tested at temperatures below freezing with varying degrees of success (viability). Collaboration was initiated with University and SEA-AR personnel from 8 different locations in the U.S. to obtain cultures for freezing. Freezing of viable tissue cultures of date palm will aid plant breeders to hold tissue cultures for propagation of high-quality date palms. Tissue culture propagation techniques represent a significant advance over current propagation technology for date palm and for some other crops.

Plant cell and tissue culture for bioproduction of valuable chemicals - Peoria, Illinois. Four Cephalotaxus harringtonia trees from Pennsylvania and Maryland contained high levels of free alkaloids throughout the year but no detectable levels of antitumor alkaloid esters. Two trees were analyzed several years earlier and found to contain low levels of the esters. Since



these plants are growing at the northern limit of their range, recent harsher winters may have been a factor in this metabolic change. Certain callus tissue cultures no longer produce the normal Cephalotaxus alkaloids. Of 14 unknown compounds found in their extracts, 6 have been identified by GC-MS as linoleic acid, oleic acid, palmitic acid, campesterol, stigmasterol, and beta-sitosterol. The 3 sterols correlated significantly with cephalotaxine and homoerythrina alkaloid production in calluses which did synthesize the normal alkaloids. Callus cultures of Datura ferox have been initiated on Murashige and Skoog medium. These cultures produce 1/100 the atropine and 1/10 the scopolamine of field-grown plants (GLC analysis). A histochemical study of the plant using Mayer's reagent, etc., showed reactive compounds (not necessarily alkaloids) in parenchyma cells and in intracellular spaces.

Higher proteins from plants derived from cells cultured in vitro - Beltsville, Maryland. A mutant cell type of rice recovered as whole plants produced progeny with 30 percent more protein than similar field controls. The mechanism of selection is not yet clear even though the design of the situation was for improved lysine. The cloning of potato spindle tuber viroid in E. coli was accomplished. Clones with the largest DNA of inserts (among hundred) was analyzed by restriction mapping. This demonstrates the utility of purified probes for processing viroid, viruses, and plant genes. Anther culture of wheat for the derivation of haploids has been applied to commercial wheats and doubled haploids tested under field conditions for genetic stability. The initial tests show that androgenesis will be very useful to wheat breeding and selection.

The portion of the Agrobacterium tumefaciens Ti plasmid transferred to the plant (T-DNA) during tumorigenesis mapped - Madison, Wisconsin. Radioactive mRNA from tumor tissue hybridizes to T-DNA indicating that this DNA is transcribed in tumor tissue. Transcription across the T-DNA is non-uniform and transcription between different crown gall cultures is non-uniform. These results, coupled with measurements of octopine synthase activity, suggest that the gene for this crown gall-specific enzyme lies in the middle of the T-DNA. DNA clones of the middle of the T-DNA are currently being used to isolate a specific RNA from crown gall tissues. This RNA may be the message for octopine synthase. In a similar fashion, other specific RNA's will be isolated and all messages will be translated in vitro with the wheat germ translation system. Recognition of in vitro synthesized protein by our antibodies to octopine synthase may be direct proof of the origin of this crown gall-specific enzyme.

Studies of differentiation of cereal protoplasts initiated - Madison, Wisconsin. At present, no methods exist for regeneration of plants from mesophyll protoplasts of grasses such as oats (Avena sativa) and corn (Zea mays), and cell divisions are only rarely seen in cultured protoplast populations. Several initial treatments and subsequent culture conditions have been devised that increase both frequency and duration of cell division of both

oat mesophyll protoplasts and corn stem suspension protoplasts. Studies on the differentiation of Nicotiana spp. were continued. A plant has been obtained from a mixed population of protoplasts of N. tabacum and N. plumbaginifolia. The plant is now being examined to see if it has been produced by fusion of cells of these species. Conditions for differentiation of 13 cultivars of potato were examined. A medium was devised which gives good differentiation and plants from 8 of these cultivars.

Technological Objective 4: Develop technology for improving the absorption, translocation, and utilization of nutrients and water to increase crop production efficiency.

Research Locations:

Corvallis, Oregon  
Lubbock, Texas

Examples of Recent Progress:

Studies on effects of liming (pH) on the VA mycorrhization of sweetgum seedlings - Corvallis, Oregon. Initial results indicate that Glomus fasciculatus induced better leaf color and early top growth of sweetgum seedlings than G. mosseae at all 7 pH levels established by liming. The experiment is being conducted using a phosphate-deficient red-brown podzolic soil collected from the Willamette Valley foothills. Final harvest and determination of dry matter and nutrient composition of seedlings are scheduled for early summer 1980. Experiments to explore the impact of organic matter content and other soil management-alterable stress factors on VA mycorrhization are being planned.

Soil factor influence on plant growth-enhancing activities of mycorrhizal fungi - Corvallis, OR. Preliminary experiments feeding sporocarps of the VA mycorrhizal fungus Sclerocystis dussii through the gut of the earthworm have shown that the technique is workable to determine the condition and viability of passed spores present in castings. Observations suggested that residence time in the earthworm gut, available food supply, and possible amount of organic matter in the castings may influence the subsequent behavior of VA mycorrhizal fungus spores.

Experiments conducted in field and greenhouse to evaluate utility of several stress tolerance mechanisms in sorghum and cotton - Lubbock, Texas. Limited stress existed in the field during the summer. During mid to late July, data on several sorghum genotypes (1 female, 3 males, and 3 hybrids) as to daily tissue water potential components, leaf resistance, photosynthesis, etc., at different levels of mild stress were taken. Leaf water potential differences of 6 bars were apparent at midday. These genotypes were selected based on the degree of osmoregulation observed in past years. Similar data were obtained on 6 cotton varieties during active vegetative growth. No stress differentials existed in the cotton.

Technological Objective 5: Improve technology for better crop production under environmental stress.

Research Locations:

Albany, California  
Beltsville, Maryland  
Lubbock, Texas

Examples of Recent Progress:

Influence of spectral quality on plant growth and development under controlled environments - Beltsville, Maryland. By use of solutions of Ferrozine as a chemical actionometer, it was demonstrated that reduction of  $\text{Fe}^{3+}$  to  $\text{Fe}^{2+}$  measured as  $\text{Fe}^{2+}$  Ferrozine (at 562 nm) was up to 20 times greater under lamps emitting high levels of UV and blue irradiance (e.g., various fluorescent lamps) than under those emitting low levels of UV and blue irradiance (e.g., low pressure sodium and incandescent). By using a polycarbonate filter to cut off most of the UV radiation (present in any given lamp) below 385 nm, it was possible to greatly reduce the amount of Fe reduction in solution. Cutting off the UV and blue portion of the spectrum below 450 nm with a Corning (CS 3-71) glass filter resulted in a colorless solution. Small traces of UV radiation present in LPS and INC lamps could be detected by this method.

Dose-response relations for  $\text{SO}_2$  effects on the productivity of snap beans and and tomatoes - Beltsville, Maryland. A highly significant linear relationship was observed between pod production and  $\text{SO}_2$  dose and bean biomass and  $\text{SO}_2$  dose, correlation coefficients  $r=.9995$  and  $.968$ , respectively. Yield reductions were 8, 16, and 43 percent after exposure to 0.05, 0.10, and 0.25 ppm  $\text{SO}_2$ , respectively, in nonfiltered air. In carbon-filtered air the addition of 0.25 ppm  $\text{SO}_2$  reduced bean yields by only 14 percent compared to 43 percent in nonfiltered air. Consequently ambient oxidants, in combination with  $\text{SO}_2$ , the oxidants did not reduce productivity. Tomato fruit size and yields were reduced by  $\text{SO}_2$  but not fruit numbers. These research results have attracted interest by DPA who will provide some support in FY-80 so that the procedure can be used in developing protocol in FY-81 for a National Crop Loss Assessment Network involving the addition of  $\text{SO}_2$  to open-top chambers.

Studies on chemical and temperature alteration of membrane polar lipids with emphasis on modification of plant functions at low temperature - Beltsville, Maryland. Respiration of mitochondria isolated from cold hardened, non-hardened or BASF 13-338 treated wheat seedlings showed no alteration of Arrhenius plots of respiration although linolenic acid content was altered. Photosynthesis activity of wheat plants was reduced by BASF 13-338 and carbohydrate content of leaves reduced. Thus, BASF 13-338 may be affecting other metabolic processes than membrane lipids in blocking freeze hardening in wheat. This may be a direct block or through alteration of lipid biosynthesis. Preplant soil application of BASF 13-338 at 2.5, 5 and 10 pounds per acre failed to alter linolenic acid in seed lipid although previous greenhouse experiments were successful. Adverse effects on growth were



noted at 10 pounds per acre. Soil applications to greenhouse grown cotton also failed to alter seed fatty acids.

Technological Objective 6: Develop new technology for control and regulation of biochemical, physical, and morphological processes of plants.

Research Locations:

Pasadena, California  
Tifton, Georgia  
Beltsville, Maryland  
Mississippi State, Mississippi  
Ithaca, New York

Examples of Recent Progress:

New plant growth inhibitor with unique structure - Tifton, Georgia.

Chaetoglobosin K is a new fungal natural product that has plant growth inhibiting properties. It is extremely active against etiolated wheat coleoptiles at concentrations as low as  $10^{-7}$ M. It does not affect the growth of corn or tobacco plants and it is expected that it will, therefore, have very specific plant activity. It is of great interest that the molecule has a indolyl-3 substitution pattern (it is a simple indole derivative). Pergillin is a totally new molecule that is a natural product and the uniqueness of the molecule makes it an attractive template for making other molecules for possible use in agriculture and medicine.

New plant pigment may regulate plant growth processes - Beltsville, Maryland.

Certain wavelengths of far-red radiation significantly increase the translocation of fluorescein in hypocotyls of dark grown mung bean seedlings. Red and green light alone have no effect. Irradiation with green light immediately following far-red irradiation prevents the increase in translocation. In contrast, comparable irradiation with red light does not prevent the far-red induced increase in translocation. These results rule out the involvement of phytochrome; however, they do suggest the action of a new and unidentified pigment that is responsible for the far-red induced increase.

Camptothecin effective as plant growth inhibitor - Beltsville, Maryland.

Camptothecin, an alkaloid found in the tree from China, Camptotheca acuminata, inhibited the growth of newly-developed tissues in several crop plants. The compound increased the storage life of potatoes and radishes by inhibition of sprouting and root growth. Axillary bud growth of tobacco and ornamentals was inhibited by camptothecin. At a concentration that retarded growth of lawn grass ( $5 \times 10^{-5}$ M), a toxic effect was observed on crabgrass. This newly discovered type of plant growth regulator provides a basis for further studies of natural products that may be environmentally safe and effective agricultural chemicals.



Brassinosteroids show an ability to promote the growth of plants - Beltsville, Maryland. Several synthetic analogs of brassinolide were prepared. Brassinolide is a tetrahydroxy steroid isolated from rape pollen and is 2 $\alpha$ , 3 $\alpha$ , 22 $\alpha$ , 23 $\alpha$ -tetrahydroxy-24 $\alpha$ -methyl-B-homo-7-oxa-5 $\alpha$ -cholestan-6-one. Five of the analogs (Brassinosteroids) were active in enhancing the growth of bean tissue in a bioassay system. The biologically active brassinosteroids are tetrahydroxy-steroid lactones or ketones. The activity is to a large extent dependent upon the orientation of the two hydroxyls in the A ring of the steroid structure. Both hydroxyls must be free (esters are inactive) and be  $\alpha$ -oriented. The orientation of the two hydroxyls at C-22 and C-23 only slightly affects activity. Yields of lettuce and radishes were significantly increased by repeated applications to young seedlings of a low concentration (0.01 ppm) of the brassinosteroids under field conditions. Field experiments also indicate that brassinosteroid treatment of seed potatoes can increase yield of marketable potatoes.

Cotton condensed tannins are resistance factors for several cotton insects - Mississippi State, Mississippi. Research on condensed tannins indicates that these compounds seem to affect twospotted spider mites and bollworms, and may also affect feeding by leafworms. Thus, condensed tannins may have general antibiotic properties. Therefore, condensed tannins could be very important in host plant resistance.

Isolation of 15 ethionine-resistant "lines" of soybean cells that have abnormally high level of uncombined methionine - Ithaca, New York. Some of these lines also had an unusually high level of S-adenosyl methionine. The addition of methionine to soybean cotyledons in culture increased dry weight, wet weight, and methionine, aspartic acid, glycine, and alanine content of the protein. In addition, arginine, glutamic acid, phenylalanine and histidine content of the protein decreased. These changes reflect a shift in relative amounts of the two major storage proteins. Complementary DNA was obtained from an RNA fraction enriched in messenger RNA for soybean storage protein subunits. This complementary was cloned in bacterial plasmids and partially characterized. DNA has been isolated from soybean tissue culture cells. Characterization of this DNA showed that it was not degraded and that it should be a good source of storage protein genes.

Technological Objective 7: Develop technology for reducing damage to crop plants from air pollutants.

Research Locations:

Beltsville, Maryland

Examples of Recent Progress:

Potential for EDU to prevent oxidant injury evaluated - Beltsville, Maryland. Snap bean, soybean, cotton, clover and watermelon varieties were tested for O<sub>3</sub>-, SO<sub>2</sub>- and NO<sub>2</sub>-induced physiological stress, including photosynthesis inhibition, stomatal closure, leaf chlorosis, premature senescence, and

product quality. All oxidant sensitive cultivars tested showed effective O<sub>3</sub> protection within 24 hours after soil application with 50-100 mg per pot or flat. Little protection was noted in fumigations during the first several hours after treatment. Ozone tolerance persisted for 3-4 weeks. A detailed study of EDU protection during the vegetative vs. fruiting stages, using Sugar Baby watermelon showed applications at the time of fruit development gave most benefit in reducing foliar chlorosis and chronic oxidant damage. SO<sub>2</sub> + NO<sub>2</sub> gas mixtures potentiate the suppression of carbon dioxide exchange rates (CER) in sensitive leaves. Snap bean, soybean, and cotton showed a curvilinear regression between exposure dose and depressed CER. The potentiated inhibition could be accounted for in a modeled study by increased diffusive resistances effected by the gas combination. Soybean and corn leaves exposed to <sup>35</sup>SO<sub>2</sub> showed evenly labeled absorption throughout the mesophyll. Absorbed sulfite-derived solutes moved out of the leaves via the phloem to the roots of newly forming leaves. Very little radiosulfur was translocated to other mature leaves on the plant.

SO<sub>2</sub> impact on crops greater due to presence of elevated levels of oxidants - Beltsville, Maryland. Widely grown cultivars of snap beans and tomatoes were exposed to SO<sub>2</sub> during the flowering and fruiting stages in open-top chambers. The study included 7 treatments: 0.0, 0.05, 0.10, and 0.25 ppm SO<sub>2</sub> in carbon-filtered air (to remove ambient oxidants), and field plots without chambers. The plants were exposed to SO<sub>2</sub> 6 hr/day, 5 days per week. Bean yield data showed a highly significant linear relationship between pod production and SO<sub>2</sub> dose in nonfiltered air (correlation coefficient  $r = .9995$ ). Yield reductions in nonfiltered air containing the 3 exposure levels of SO<sub>2</sub> were 8, 16, and 43 percent, respectively. In carbon-filtered air SO<sub>2</sub> reduced bean yields 14 percent vs. 43 percent in nonfiltered air. In the absence of SO<sub>2</sub> culture in carbon filtered as compared to non-filtered air showed no statistically significant increase in bean yields, indicating relatively low seasonal oxidant pollutant levels in 1979. The effects of SO<sub>2</sub> on tomatoes in the same chambers were similar. The increased SO<sub>2</sub> doses caused premature senescence of tomato leaves and leaf loss. A reduction in the size and yield of tomato fruit was also indicated. Environmental conditions in 1979 were very favorable for plant growth and high sensitivity to air pollutants. The results showed SO<sub>2</sub> impact on crops is greater because of the presence of elevated levels of oxidants in ambient air.

## P U B L I C A T I O N S

### Albany, California

Finkle, B. J. and J. M. Ulrich. 1979. Effects of cryoprotectants in combination on the survival of sugarcane cells. *Plant Physiol.* 63:598-604.

Scherer, J. R., R. G. Snyder, and S. J. Krause. 1979. Resolution of crystal split fundamentals of polyethylene by Raman difference spectroscopy. *J. Phys. Chem.* 83:626.

Snyder, R. G. and J. R. Scherer. 1979. Band structure in the C-H stretching region of the Raman spectrum of the extended polymethylene chain: Influence of Fermi resonance. *J. Chem. Phys.* 71:3221.

Snyder, R. G. 1979. Vibrational correlation splitting and chain packing for crystalline n-alkanes. *J. Chem. Phys.* 71:3229.

Ulrich, J. M., B. J. Finkle, P. H. Moore, and H. Ginoza. 1979. Effect of a mixture of cryoprotectants in attaining liquid nitrogen survival of callus cultures of a tropical plant. *Cryobiol.* 16:550-556.

Windle, J. J. and R. Scherer. 1979. A spin probe study of cross-linked dextran gels in aqueous media as a model for cell walls. *In: Magnetic Resonance and Related Phenomena*. E. Kundla, E. Lippmaa, and T. Saluvere, Eds. Springer, Berlin. 512 pp.

### Gainesville, Florida

Tien, T. M., M. H. Gaskins, and D. H. Hubbell. 1979. Plant growth substances produced by Azospirillum brasilense and their effect on the growth of pearl millet (Pennisetum americanum L.). *Appl. Environ. Microbiol.* 37:1016-1024.

Umali-Garcia, M., D. H. Hubbell, M. H. Gaskins, and F. B. Dazzo. 1980. Association of Azospirillum with grass roots. *Appl. Environ. Microbiol.* 39:219-226.

### Athens, Georgia

Morgan, J. A., R. H. Brown, and B. Reger. 1980. Photosynthesis in grass species differing in carbon dioxide fixation pathways. III. Oxygen response and enzyme activities of species in the Laxa group of Panicum. *Plant Physiol.* 65:156-159.

### Tifton, Georgia

Cutler, H. G., R. J. Cole, R. H. Cox, and J. M. Wells. 1979. Fungal Metabolites: Interesting new plant growth inhibitors. Proc. 6th Ann. Plant Growth Regulator Working Group. pp 87-91.

Cutler, H. G., F. G. Crumley, R. H. Cox, R. J. Cole, J. W. Doner, J. P. Stringer, F. M. Latterell, J. E. Thean, and A. E. Rossi. 1980. Chaetoglobosin K: A new plant growth inhibitor and toxin from Diplodia macrospora. J. Agric. Food Chem. 28:139-142.

### Peoria, Illinois

Delfel, N. E. 1979. A simple device for rinsing microliter syringes. J. Chem. Educ. 56:525.

Eskins, K. and D. J. Banks. 1979. The relationship of accessory pigments to chlorophyll a content in chlorophyll-deficient peanut and soybean varieties. Photochem. and Photobiol. 30:585-588.

Eskins, K. and H. J. Dutton. 1979. Sample preparation for high-performance liquid chromatography of higher plant pigments. Anal. Chem. 51:1885-1886.

Govinjee and P. A. Jursinic. 1979. Photosynthesis and fast changes in light emission by green plants. In: Photochemical and Photobiological Reviews. Vol. 4. Kendrick C. Smith, Ed. Plenum Press, New York. pp 125-205.

Jursinic, P. 1979. Flash-yield pattern for photosynthetic oxygen evolution in Chlorella and chloroplasts as a function of excitation intensity. Arch. Biochem. Biophys. 196:484-492.

Mort, A. J., M. E. Slodki, R. D. Plattner, and W. D. Bauer. 1979. The initiation of infections in soybean by Rhizobium. 4. Molecular Structure of biologically active R. japonicum polysaccharides. Plant Physiol 63(5):S135.

Newton, J. W. and A. I. Herman. 1979. Isolation of cyanobacteria from the aquatic fern, Azolla. Arch. Microbiol. 120:161-165.

Newton, J. W., D. D. Tyler, and M. E. Slodki. 1979. Effect of UV-B (280 to 320 nm) radiation on blue-green algae (cyanobacteria); possible biological indicators of stratospheric ozone depletion. Appl. Environ. Microbiol. 37:1137-1141.

### Urbana, Illinois

Arntzen, C. J., C. L. Ditto, and P. E. Brewer. 1979. Chloroplast membrane alterations in triazine-resistant Amaranthus retroflexus biotypes. Proc. Natl. Acad. Sci. USA 76:278-282.



- Brewer, P. E., C. J. Arntzen, and F. W. Slife. 1979. Effects of atrazine, cyanazine, and procyzazine on the photochemical reactions of isolated chloroplasts. *Weed Science* 27:300-308.
- Burke, J. J., K. E. Steinback, and C. J. Arntzen. 1979. Analysis of the light-harvesting pigment-protein complex of wild type and chlorophyll b-less mutant of barley. *Plant Physiol.* 63:237-243.
- Leto, K., J. Beckett, and C. J. Arntzen. 1979. Effects of chromosome arm dosage on the activity of isolated maize chloroplasts. *Maize Genetics Coop. News Lett.* 53:35-37.
- Pfister, K. and C. J. Arntzen. 1979. The mode of action of photosystem II specific inhibitors in herbicide-resistant weed biotypes. *Z. Naturforsch.* 34c:996-1009.
- Pfister, K., S. Radosevich, and C. J. Arntzen. 1979. Modification of herbicide binding to photosystem II (PS II) in two biotypes of Senecio vulgaris L. *Plant Physiol.* 64:995-999.
- Portis, A., C. Newton, W. Pangborn, and D. Papahadjopoulos. 1979. Studies on the mechanism of membrane fusion: Evidence for an intermembrane  $\text{Ca}^{2+}$ -phospholipid complex, synergism with  $\text{Mg}^{2+}$ , and inhibition by Spectrin. *Biochem.* 18:780-790.
- Radosevich, A. R., K. E. Steinback, and C. J. Arntzen. 1979. Effect of photosystem II inhibitors on thylakoid membranes of two common groundsel biotypes. *Weed Sci.* 27:216-218.
- Richard, E. P., Jr., J. R. Gross, and C. J. Arntzen. 1979. Glyphosphate does not inhibit photosynthetic electron transport and phosphorylation in pea (Pisum sativum) chloroplasts. *Weed Sci.* 27:684-688.
- Somerville, C. R. and W. L. Ogren. 1979. A phosphoglycolate phosphatase-deficient mutant of Arabidopsis. *Nature* 280:833-836.
- Staehelin, L. A. and C. J. Arntzen. 1979. Effects of ions and gravity forces on the supramolecular organization and excitation energy distribution in chloroplast membranes. In: Chlorophyll Organization and Energy Transfer in Photosynthesis. Ciba Foundation Symposium 61. pp 147-175.
- Steinback, K. E., J. J. Burke, and C. J. Arntzen. 1979. Evidence for the role of surface-exposed segments of the light-harvesting complex in cation-mediated control of chloroplast structure and function. *Arch. Biochem. Biophys.* 195:546-557.
- Stewart, T. P., S. W. Hui, A. R. Portis, Jr., and D. Papahadjopoulos. 1979. Complex phase mixing of phosphatidylcholine and phosphatidylserine in multi-lamellar membrane vesicles. *Biochim. Biophys. Acta* 556:1-16.

## Beltsville, Maryland

- Bennett, J. H. 1979. Foliar exchange of gases. In: Handbook of Methodology for the Assessment of Air Pollutant Effects on Vegetation. Chapter 10. W. W. Heck, S. V. Krupa, and S. N. Linzon, Eds. Air Pollut. Control Assoc., Pittsburg.
- Bennett, J. H., E. H. Lee, and H. E. Heggestad. 1979. Physiological effects of EDU on ozone sensitive leaves. Plant Physiol. 63:S152.
- Berry, W. L., D. P. Ormrod, P. A. Hammer, J. C. McFarlane, D. T. Krizek, R. W. Langhans, and T. W. Tibbitts. 1979. Uniformity studies with lettuce: Results of growth and tissue analysis. Phytotron. Newslett. 19:62-66.
- Brown, J. C., H. M. Cathey, J. H. Bennett, and R. W. Thimijan. 1979. Effects of light and temperature on  $\text{Fe}^{+3}$  reduction and chlorophyll concentration in plants. Agron. J. 71:1015-1021.
- Brown, J. C., C. D. Foy, J. H. Bennett, and M. N. Christiansen. 1979. Two light sources differentially affected iron reduction and growth of cotton. Plant Physiol. 63:692-695.
- Bunce, J. A., B. F. Chabot, and L. N. Miller. 1979. Role of annual leaf carbon balance in the distribution plant species along an elevational gradient. Bot. Gaz. 140:288-294.
- Chabot, B. F. and J. A. Bunce. 1979. Drought stress effects on leaf carbon balance. In: Topics in Plant Population Biology. O. S. Solbrig, S. Jain, G. B. Johnson, and P. H. Raven, Eds. Columbia Univ. Press, N.Y. pp 338-355.
- Chatterton, N. J. and J. E. Silvius. 1979. Photosynthate partitioning into starch in soybean leaves. I. Effects of photoperiod versus photosynthetic period duration. Plant Physiol. 64:749-753.
- Christiansen, M. N. 1979. Movement and loss of organic substances from roots at low temperature. In: Low Temperature Stress in Crop Plants: The Role of the Membrane. U.S./Australia/New Zealand Seminar Proc. Academic Press. pp 115-122.
- Cress, D. E., P. J. Jackson, A. Kadouri, Y. Chu, and K. G. Lark. 1978. DNA replication in soybean protoplasts and suspension cultured cells: Comparison of exponential and fluorodeoxyuridine synchronized cultures. Planta 143:241.
- DeBonte, L. R., K. C. Vaughn, K. G. Wilson, and G. W. Scheffer. 1979. Paternal alteration of organelle. Plant Physiol. 63:S144.

- Grove, M. D., G. F. Spencer, W. K. Rohwedder, N. Mandava, J. F. Worley, J. D. Warthen, G. L. Steffens, J. L. Flippen-Anderson, and J. C. Cook. 1979. Brassinolide: A unique plant growth promoting steriod from Brassica napus pollen. *Nature* 281:216-217.
- Howell, R. K., E. J. Koch, and L. P. Rose, Jr. 1979. Field assessment of air pollution-induced soybean yield losses. *Agron. J.* 71:285-288.
- Howell, R. K., L. P. Rose, Jr., and R. C. Leffel. 1980. Field testing soybeans for possible residual air pollution and seed size effects on subsequent crop seed yields. *J. Environ. Qual.* 8:66-68.
- Krizek, D. T. 1979. Report - Controlled Environments Working Conferences. *Hort. Sci.* 14(3):287.
- Krizek, D. T. 1979. Carbon dioxide: Guidelines. In: Controlled Environment Guidelines for Plant Research. T. W. Tibbitts and T. T. Kozlowski, Eds. Academic Press, New York. pp 241-269.
- Krizek, D. T. 1979. Influence of atmospheric parameters: Carbon dioxide enrichment. In: Cotton Physiology - A Treatise. Chapter I, Flowering, fruiting, and cut-out of cotton. J. M. Stewart, Ed. Proc. Beltwide Cotton Prod. Res. Conf. pp 283-291.
- Krizek, D. T. and E. J. Koch. 1979. Use of regression analysis to estimate UV spectral irradiance from broad band radiometer readings under FS-40 fluorescent sunlamps filtered with cellulose acetate. *Photochem. Photobiol.* 30:483-489.
- Kuykendall, L. D. 1979. Transfer of R factors to and between genetically marked sublines of Rhizobium japonicum. *App. and Environ. Microbiol.* 37: 862-866.
- Lark, K. G. and D. E. Cress. 1978. Cell division and DNA synthesis in plant cells. In: Frontiers of Plant Tissue Culture 1978. T. A. Thorpe, Ed. Internat. Assoc. for Plant Tissue Culture, Calgary, Canada. pp 179-189.
- Lee, E. H. and J. H. Bennett. 1979. Comparative studies of foliar protection from ozone induced by EDU in greenhouse and growth chamber preconditioned plants. Proc. 6th Ann. Plant Growth Regulator Working Group. p 218.
- Lieberman, M., S. Y. Wang, and L. D. Owens. 1979. Ethylene production by callus and suspension cells from cortex tissue of postclimacteric apples. *Plant Physiol.* 63:811-815.
- Limberg, M., D. E. Cress, and K. G. Lark. 1979. Variants of soybean cells which can grow in suspension with maltose as a carbon-energy source. *Plant Physiol.* 63:718-721.

- Mandava, N. 1979. Trace plant constituents - Methods and analysis. Proc. Ninth Material Res. Sympos. on Trace Organic Analysis. NBS Spec. Pub. 519: 803-807.
- Meiners, J. P. and H. E. Heggestad. 1979. Evaluation of snap bean cultivars for resistance to ambient oxidants in field plots and to ozone in chambers. Plant Disease Reporter 63(4):273-277.
- Orion, D., W. P. Wergin, and B. Y. Endo. 1979. The influence of two synthetic media on development of the root-knot nematode on excised tomato roots. J. Nematol. 11:310.
- Ormrod, D. P., and D. T. Krizek. 1979. Environmental stresses in controlled environments. Phytotron. Newslett. 19:41-51.
- Owens, L. D. 1979. Binding of COLE1-kan plasmid DNA by tobacco protoplasts: Nonexpression of plasmid gene. Plant Physiol. 63:683-686.
- Owens, L. D. 1979. Kanamycin promotes morphogenesis of plant tissues. Plant Sci. Lett. 16:225-230.
- Rodes, P., F. Hyman, S. D. Kung, and G. W. Schaeffer. 1979. Biochemical characterization of a yellow mutation of tobacco. Plant Physiol. 63:S160.
- Sayre, R. M., J. R. Adams, and W. P. Wergin. 1979. Bacterial parasite of ■ cladocerans morphology, development in vivo, and taxonomic relationships with Pasteuria ramosa. Metchnikoff 1888. Int. J. Sytem. Bact. 27:252-262.
- Sayre, R. M., and W. P. Wergin. 1979. The use of SEM to clarify and evaluate the parasites and predators of past nematodes. SEM/SEM Inc. 3: 87-91.
- Schaeffer, G. W., P. S. Baenziger, and J. Worley. 1979. Haploid plant development from anthers and in vitro embryo culture of commercial wheats. (Triticum aestivum L.) Crop Sci. 19:697-702.
- Silvius, J. E., F. W. Snyder, and D. F. Kremer. 1979. Comparative enzymic studies of sucrose metabolism in sugarbeet taproots and fibrous roots. Plant Physiol. 63:S598.
- Silvius, J. E., and F. W. Snyder. 1979. Comparative enzymic studies of sucrose metabolism in sugarbeet taproots and fibrous roots. Plant Physiol. 64:1070-1073.
- Silvius, J. E., N. J. Chatterton, and D. F. Kremer. 1979. Photosynthate partitioning in soybean leaves at two irradiance levels. Comparative responses of acclimated and unacclimated leaves. Plant Physiol. 64:872-875.
- Silvius, J. E. and F. W. Snyder. 1979. Photosynthate partitioning and enzymes of sucrose metabolism in sugarbeet roots. Physiol. Plant. 46:169-173.



- Skelly, J. M., M. F. George, H. E. Heggestad, and D. T. Krizek. 1979. Air pollution and radiation stresses. In: Modification of the Aerial Environment of Plants, ASAE Monograph 2. B. J. Barfield and J. F. Garber, Eds. Amer. Soc. of Agric. Engr., St. Joseph, Michigan. 538 pp.
- St. John, J. B., F. R. Rittig, E. N. Ashworth, and M. N. Christiansen. 1979. Structure-activity correlations in control of linolenic acid content of plant membranes by substituted pyridazinones. In: Pure and Applied Chemistry Advances in Pesticide Chemistry Part 2. H. Geissbuhler, Ed. Pergamon Press, Oxford and New York.
- St. John, J. B., M. N. Christiansen, E. N. Ashworth, and W. A. Gentner. 1979. Effect of BASF 13-338, a substituted pyridazinone, on linolenic acid levels and winter hardiness of cereals. *Crop Sci.* 19:65-69
- Steffens, G. L., J. G. Buta, L. E. Gregory, N. Mandava, W. J. Meudt, and J. F. Worley. 1979. New plant growth regulators isolated from higher plants. In: Advances in Pesticide Science. H. Geissbuhler, Ed. pp 343-346.
- Tanada, T. 1979. Phytochrome and gravity induced electrical charges in plant development: Speculations on their origins and roles. *What's New in Plant Physiol.* 10:17-20.
- Terrell, E. E. and W. P. Wergin. 1979. Scanning electron microscopy and energy dispersive X-ray analysis of leaf epidermis in Zizania (Gramineae). *SEM/SEM Inc.* 3:81-88.
- Thompson, M. J., N. Mandava, J. L. Flippen-Anderson, J. F. Worley, S. R. Dutky, and W. E. Robbins. 1979. 1979. Synthesis of brassinosteroids: New plant growth promoting steroids. *J. Org. Chem.* 44:5002-5004.
- Van Berkum, P. and C. Sloger. 1979. Comparing immediate acetylene reduction by grasses to legumes. *Plant Physiol.* 63:S85.
- Van Berkum, P. and C. Sloger. 1979. Immediate acetylene reduction by excised grass roots not previously preincubated at low oxygen tensions. *Plant Physiol.* 64:739-743.
- Wang, C. Y., J. G. Buta, H. E. Moline, and H. W. Hrischka. 1980. Potato sprouting inhibition by camptothecin, a naturally occurring plant growth regulator. *J. Amer. Hort. Sci.* 105(1):120-124.
- Worley, J. F., D. W. Spaulding, and J. G. Buta. 1979. Inhibition of Xanthi tobacco sucker growth by camptothecin. *Tobacco Sci.* 23:43-44.
- Yopp, J. H., G. C. Colclasure, and N. Mandava. 1979. Effect of brassin-complex on auxin and gibberellin mediated effects in the morphogenesis of the etiolated bean hypocotyl. *Physiol. Plant.* 46:247-254.

St. Paul, Minnesota

Heichel, G. H. and C. P. Vance. 1979. Nitrate-N and Rhizobium strain roles in alfalfa seedling nodulation and growth. Crop Sci. 19:513-518.

Vance, C. P., G. H. Heichel, D. K. Barnes, J. W. Bryan, and L. E. Johnson. 1979. Nitrogen fixation, nodule development and vegetative regrowth of alfalfa (Medicago sativa L.) following harvest. Plant Physiol. 64:1-8.

Vance, C. P. and G. H. Heichel. 1979. Distribution of nitrate reductase in alfalfa. Plant Physiol. 63:S130.

Viands, D. R., C. P. Vance, G. H. Heichel, and D. K. Barnes. 1979. An ineffective nitrogen fixation trait in alfalfa. Crop Sci. 19:905-908.

Volz, M. G. and G. H. Heichel. 1979. Nitrogen transformations and microbial population dynamics in soil amended with fermentation and residue. J. Environ. Qual. 8:434-439.

Ithaca, New York

Anderson, N. W. and J. F. Thompson. 1979. Cystine lyase: $\beta$ -cystathionase from turnip roots. Phytochem. 18:1953-1958.

Beachy, R. N., J. F. Thompson, and J. T. Madison. 1979. Isolation and characterization of messenger RNA's that code for the subunits of soybean seed protein. In: The Plant Seed: Development, Preservation and Germination. I. Rubenstein, B. G. Gengenbach, R. L. Phillips, and C. E. Green, Eds. Academic Press, New York. pp 67-84.

Lugg, D. G. and T. R. Sinclair. 1979. A survey of soybean cultivars for variability in specific leaf weight. Crop Sci. 19:887-892.

Lugg, D. G. and T. R. Sinclair. 1979. Variation in stomatal density with leaf position in field-grown soybeans. Crop Sci. 19:407-409.

Sinclair, T. R. and R. H. Rand. 1979. Mathematical analysis of cell CO<sub>2</sub> exchange under high CO<sub>2</sub> concentrations. Photosynthetica 13:239-244.

Stoffella, P. J., R. F. Sansted, R. W. Zobel, and L. W. Hymes. 1979. Root characteristics of some black beans. Phaseolus vulgaris L., I. Relationship of root size to lodging and yield. Crop Sci. 19:823-825.

Stoffella, P. J., R. F. Sansted, R. W. Zobel, and L. H. Hymes. 1979. Foot characteristics of some black beans. Phaseolus vulgaris L. II. Gross morphological differences among cultivars and selected lines. Crop Sci. 19:826-830.

Zobel, R. W. 1979. Rhizogenetics of soybean. Proc. of World Soybean Congress II. pp 73-88.

Zobel, R. W. and D. H. Wallace. 1978. Potential for nitrogen fixation. Hort. Sci. 13:679-682.

Beachy, R. N., K. A. Barton, J. F. Thompson, J. T. Madison, and N. P. Jarvis. 1980. The mRNS's that code for soybean seed proteins. In: Genome Organization and Expression in Plants. C. Leaver, Ed. Plenum Press, New York.

#### Raleigh, North Carolina

Barber, L. E. 1980. Enumeration, effectiveness, and pH resistance of Rhizobium meliloti from soil, Soil Sci. Soc. Amer. J. 43:1145-1148.

Barber, L. E. and J. C. Ensign. 1979. Methane formation and release in a small Wisconsin lake. Geomicrobiol. 1:341-352.

Barber, L. E. and W. M. Murphy. 1979. Inoculation of Chilean alfalfa and lentils. Proc. VII N. Amer. Rhizobium Conference. p 34.

Barber, L. E., S. A. Russell, and H. J. Evans. 1979. Inoculation of millet with Azospirillum. Plant and Soil 52:49-57.

Burke, J. J., K. E. Steinback, and C. J. Arntzen. 1979. Analysis of the light-harvesting pigment protein complex of wild-type and a chlorophyll b-less mutant of barley. Plant Physiol. 63:237-243.

Edwards, G. E. and S. C. Huber. 1979. C<sub>4</sub> metabolism in isolated cells and protoplasts. In: Encyclopedia of Plant Physiol. Vol. 6, Photosynthesis II. Photosynthetic carbon metabolism and related processes. M. Gibbs and E. Latzko, Eds. Springer-Verlag, Berlin. pp 102-111.

Gurley, W. B., J. Callis, and J. D. Kemp. 1979. Transcription of plasmid-derived sequences by octopine-type crown gall tumors. Plant Physiol. 63: Supp.

Gurley, W. B., J. D. Kemp, M. J. Albert, D. W. Sutton, and J. Callis. 1979. Transcription of Ti-plasmid derived sequences in three octopine-type crown gall tumor lines. Proc. Nat. Acad. Sci. USA 76:2828-2832.

Huber, S. C. 1979. Effect of pH on chloroplast photosynthesis. Inhibition of O<sub>2</sub> evolution by inorganic phosphate and magnesium. Biochim. Biophys. Acta 545:131-140.

Huber, S. C. 1979. Orthophosphate control of glucose-6-phosphate dehydrogenase light modulation in relation to the induction phase of chloroplast photosynthesis. *Plant Physiol.* 64:846-851.

Huber, S. C. and D. E. Moreland. 1979. Permeability properties of mung bean mitochondria and changes during energization. *Plant Physiol.* 64:115-119.

Israel, D. W. 1979. Transport of nitrogen by plants. *Agron. Abs.* p 89.

Israel, D.W. and P. R. McClure. 1979. Nitrogen translocation in the xylem of soybeans. In: Proc. World Soybean Res. Conf. II. F. T. Corbin, Ed. Westview Press, Boulder, Colorado. p 60.

Jenkins, M. B. and L. E. Barber. 1979. Effect of commercial inoculants on the establishment of Trifolium subterraneum in southwest Oregon soils. *Proc. VII N. Amer. Rhizobium Conf.* p 47.

McClure, P. R. and D. W. Israel. 1979. Transport of nitrogen in the xylem of soybean plants. *Plant Physiol.* 64:411-416.

McClure, P. R. and D. W. Israel. 1979. Xylem sap nitrogen content as an indicator of N<sub>2</sub> fixation in soybean plants. *Plant Physiol.* 63:S84.

Moreland, D. E. and S. C. Huber. 1979. Inhibition of photosynthesis and respiration by substituted 2,6-dinitroaniline herbicides. III. Effects on electron transport and membrane properties of isolated mung bean mitochondria. *Pest. Biochem. Physiol.* 11:247-257.

Murphy, W. M., L. E. Barber, and C. Hagedorn. 1979. Inoculant effects on alfalfa nodulation. *Commun. Soil Sci. Pl. Anal.* 10:1291-1297.

Rapp, Barbara J., J. D. Kemp, and F. White. 1979. Isolation of a non-tumor inducing mutant of the Ti plasmid of Agrobacterium tumefaciens strain B6. *Can. J. Microbiol.* 25:291-297.

Steinback, K. E., J. J. Burke, and C. J. Arntzen. 1979. Evidence for the role of surface-exposed segments of the light-harvesting complex in cation-mediated control of chloroplast structure and function. *Arch. Biochem. Biophys.* 195:546-557.



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## National Research Program 20180

### CROP POLLINATION AND HONEY PRODUCTION

This National Research Program involves research designed to improve beekeeping management for honey production and crop pollination. Studies include colony management, control of diseases and pests of bees, honey bee breeding and genetics, bee poisoning by pesticides, wild bee biology, properties of apiary products and the use of bees in pollinating crops. The major problem facing the beekeeping industry remains the hazardous relationship between bees and pesticides. Emphasis on this problem has been on field studies in the southwest. As the laboratory in Laramie, Wyoming, completes its development, emphasis is expected to shift towards laboratory efforts to understand the problems so that new approaches towards solutions can be undertaken.

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Technological Objective 1: Improve management of honey bees for most effective crop pollination and honey production.

#### Research Locations:

Tucson, Arizona  
Baton Rouge, Louisiana  
Stillwater, Oklahoma  
Madison, Wisconsin

#### Examples of Recent Progress:

Microbes and Amino Acids were Analyzed in the Food of Honey Bees - Tucson, Arizona. As part of an extensive project on the microbiology and biochemistry of pollen and bee bread, additional molds from almond pollen from the flower; from pollen pellets from traps placed on bee hives in the orchard; and from pollen stored in the comb cells of the hive (bee bread) for 1, 3, and 6 weeks were identified as Penicillium crustosum, P. corylophilum, P. chrysogenum, Rhizopus nigricans, Arthrrium sphaerosperum, Mucor racemosus, Chaetomium sp., and Aspergillus flavus var. columnaris. Four of these are new records of molds associated with honey bees. Definition of the microflora of pollen and bee bread will be the basis of future work on the contributions of individual microbes to the fermentation and preservation of pollen.

Onion Seed Set Indicate Poor Bee Distribution - Tucson, Arizona. Seed set on the perimeter of a 22 ha. onion field were 40 to 50% of the potential, but the interior yielded only 3% of the potential, thus indicating the need to place colonies closer than 200 m from the middle of a field or providing other means of "encouraging" the bees to visit the field more uniformly viz. landmarks.

Honey Bees Visited Cotton Flowers Poorly - Tucson, Arizona. Cotton flowers produced a mean of 25  $\mu$ l nectar containing about 20% sugar, but the honey bees mainly utilized extra-floral sources of nectar. Differences in volume and concentration of floral nectar were not statistically significant, but further work is needed to select genotypes attractive to honey bees for use in hybrid breeding programs.

Sugar Concentration and Volume of Nectar of 11 Gynoecious and One Monoecious Pickling Cucumber Cultivars Determined - Tucson, Arizona. This is another phase of the long range study of honey bee preference for gynoecious and monoecious cucumber cultivars. The volumes and sugar concentrations of 10 male and 10 female flowers of the 12 cultivars in the test have been measured. Additional amounts of nectar were collected and put onto No. 1 Whatman paper for later analysis for the types of sugar present in cucumber nectar. These results will be compared to honey bee preference and rank correlations computed to determine significance.

Artificial - Natural Material Food Developed - Tucson, Arizona. After several trials, a mixture has been prepared which maintains a better degree of cake moistness but further testing should make it equal to the diet developed by Dr. Herbert in which wheat is used. Bees eat the diet when fed to large colonies.

Standardized Nutritional Bioassay for Honey Bees Developed - Tucson, Arizona. This is finalized and submitted for publication in a scientific agricultural journal. This is the major accomplishment of 3 year's work in the area of honey bee nutrition. Each test takes only 2 weeks and gives replicated data on diet consumption and brood-rearing. Continued use of this test will permit rapid screening of new diet substances and better-controlled experiments of honey bee physiology - nutritional biochemistry.

Relative Nutritional Value of Several Pollens, Pollen Substitutes, and Artificial Diets Determined - Tucson, Arizona. Using the new nutritional bioassay, 10 different pollens were rated as to their relative brood-rearing capability: almond, saguaro, and Lesquerella mustard were equally good; pigweed and cottonwood were of low value and dandelion was of no brood-rearing value.

Dandelion and Dandelion Plus Arginine for Brood-rearing Evaluated - Tucson, Arizona. The literature indicates that dandelion supplemented with arginine (a basic, essential amino acid) supports brood-rearing whereas dandelion alone will not. We were not able to confirm the efficacy of arginine in dandelion diets. In fact, even adding 25% saguaro pollen just barely began to overcome the brood-rearing problems of dandelion pollen.

The significance of the above will come from continued use of a bioassay to elucidate nutritional problems and deficiencies in natural and artificial diets; in understanding normal honey bee nutrition; and in studying nutrition and colony development.



Fluorescent Phenolic Compounds in Nectar Identified - Tucson, Arizona. Using a combination of chromatographic techniques (PC, TLC, HPLC, GC and GC/ms), fluorescent nectars from Agave, Fremontia, Allium, Daucus and Prunus were analyzed for their phenolic constituents. Preliminary identifications have revealed that water soluble phenolic glycosides (specifically isoflavones) are responsible for the intense blue fluorescence in many nectars. Honey bees have been demonstrated to see the fluorescence and/or UV absorbance of those nectars and probably use them as floral cues to delimit flowers with and without nectar rewards (Thorp and Buchmann, unpublished).

Foraging Activity, Competition with Native Species, and Temperature Regulation in the Honey Bee Studied - Tucson, Arizona. Foraging at high (>30°C) temperatures by honey bees (Apis mellifera L.) is facilitated by evaporative cooling (previously reported by Heinrich) and by the use of the hive as a heat sink by returning workers (this study). These mechanisms enable the bees to forage at ambient temperatures in excess of 46°C. Nevertheless, field observations indicate that foraging activity declines at temperatures in excess of 30°C. In particular, it is shown that bees will cease foraging even though nectar remains in the flowers when average daily temperatures exceed this value.

Improved Management Increases Honey Production and Pollination - Baton Rouge, Louisiana. Management techniques were developed which regulate honey bee foraging motivation to appropriate levels throughout the blooming season. These techniques can cause bees to gather 20-30% more honey annually and consequently improve the pollination activity of a colony of bees.

Insulation Improves Overwintering of Colonies - Madison, Wisconsin. Winter stores consumed were found to be significantly less and brood rearing was increased by insulating colonies of honey bees being overwintered outdoors. An insulating cover formed from corrugated sheet plastic and placed over the colony provided sufficient protection to produce the desirable spring colony condition indicated above. The plastic was white in color and translucent to permit the penetration of sunlight. A 1-1/2-inch air space was maintained between the cover and the exterior of the hive bodies and an extended entrance through the cover provided outside access for the bees. The covers were installed in late fall and removed in spring after cold weather conditions were minimal. A savings is realized from the reduced stores consumption and colony condition and spring buildup is improved by this method of winter insulation.

Improved Soy-bean Flours Available - Madison, Wisconsin. A major obstacle to prebloom spring buildup of honey bee populations has in recent years been the lack of a suitable and economical substitute for expeller processed soyflour. Expeller processed flour has been the material of choice for more than 25 years but is no longer available. We were able to show that there are now at least two other soyflour products available with which bees can rear brood for up to 4 weeks at levels comparable to

those obtained with pollen. These materials are inexpensive and readily available. Further we have been able to provide guidelines for individual beekeepers to select suitable products from other sources if necessary.

Technological Objective 2: Improve methods of protecting bees from pesticides, diseases, pests and pollution.

Research Locations:

Baton Rouge, Louisiana  
Beltsville, Maryland  
Laramie, Wyoming

Examples of Recent Progress:

Disease Resistant Bees Found to also be Long Lived - Baton Rouge, Louisiana. Honey bees were evaluated for disease resistance, longevity and sugar syrup storage activity; and genetic variation was found for all three. Those bees which were most resistant to a major bee disease (nosema) were generally also longest lived without disease. Sugar syrup storage activity was not related to life span or disease resistance. These studies greatly increase the efficiency of bee breeders. They may select for high honey production without fearing they will produce short-lived or nosema-susceptible bees. Also they may select for either nosema resistance or long life and have the other almost automatically improve.

Tolerance to Carbaryl in Honey Bees Increased by Selection - Baton Rouge, Louisiana. Nine generations of genetic selection for survival to carbaryl produced pesticide tolerance in newly emerged workers and a stronger tolerance to older workers. These results provide two strong warnings for the apiculture industry. First, naturally developing resistance in older bees may kill colonies by killing younger bees. Second, fully developed resistance will cause pesticide contamination problems now not known to exist.

Wax Moths may be Controlled by New Concept - Baton Rouge, Louisiana. A new concept of pest control based on inoculative releases of insects that contain randomly induced semi-lethal mutations has been developed. To control a pest effectively, natural selective pressures must function to select for individuals that will survive and reproduce at a high level when outcrossed, making the semi-lethal mutations persistent in the population. Inbreeding will eventually cause lethality and population control. A large field test resulted in effective control of the wax moth in Alabama by inoculative releases in 14 areas. The new decreased fitness concept of pest control is of significant importance with immediate relevance to crop protection because the principles involved are general and may apply to any breeding pest population.

Honey Bee Population Model Developed - Beltsville, Maryland. An interactive model for computer simulations of honey bee populations has been developed. This model can be used to simulate the impact of diseases,

pesticides and swarms on honey bee population. The model maintains a log of honey and pollen gains as well as the populations of bees.

Non-chemical Control of Greater Wax Moths Developed - Beltsville, Maryland. A product containing Bacillus thuringiensis has been developed and tested which was found to be effective against the wax moth. This product can be used on equipment occupied by bees with no adverse effects. The data collected by this laboratory is being used to obtain approval of a label from the EPA.

New Spiroplasma Named - Beltsville, Maryland. The honey bee spiroplasma has been named Spiroplasma citri, serogroup 1, subgroup 2. This organism has now been isolated from the blossoms of honeysuckle, Lonicera morrowii and two specimens of bumble bees. Thus blossoms and other arthropods are potential reservoirs for this recently discovered disease of honey bees.

Adult Bees Self-generate Sterols for Feeding to Larvae - Beltsville, Maryland. A study of sterol requirements for brood rearing in honey bees indicates that adult bees provide sterols to the developing brood from their own sterol pools. This means that sterols could be limited in diets to maintain brood rearing. Isofucosterol was detected for the first time in honey bees.

Pesticide Losses to Honey Bees Reduced in Desert Southwest - Laramie, Wyoming. In a 4-year study (1976-1979) to reduce honey bee losses due to pesticides applied to cotton through management practices in the hot desert southwest (Casa Blanca, Yuma and Tucson, Arizona) colonies were, in many cases, kept alive and able to store surplus honey when cotton was sprayed as many as 15 times in a single season on 5- to 7-day schedule with insecticides highly toxic to bees. Wardecker waterers developed for the study to provide water within the hive were valuable as a water source when bees were confined either with burlap sheets or in cages for 24 to 96 hr to keep them from the sprayed cotton. Hives permanently mounted on trailers for moving from sprayed to unsprayed locations for 96 hr enhanced forager survival with a minimum of colony confusion due to moving. Management practices (Wardecker waterers, shade, confinement, feeding pollen cake, Miller bottom boards, and moving on trailers) were the most beneficial when all were used in combination at the same time.

Technological Objective 3: Determine pollination requirements of economically important crops.

Research Locations:

Madison, Wisconsin

Examples of Recent Progress:

Soybean Nectar Production Affected by Soils - Madison, Wisconsin. Field studies of honey production in various soybean producing areas of the Mississippi Delta have shown that heavier soils having a pH above 6.0,



high fertility and high water availability favored maximum soybean nectar production as well as high soybean yields. This information is essential in understanding the relationships between soybean flowers and bees affecting bee pollination and yield improvement. The results of these studies are probably applicable to other crops and can lead to enhancement of honey production elsewhere. Further studies in a controlled environment are underway to further elucidate the interactions between environment and anthesis in soybeans.

Factors Affecting Electric Charges on Honey Bees Identified - Madison, Wisconsin. Past studies have shown that foraging honey bees returning to the hive carry a substantial surface electric potential back to the hive; and probably also as they approach a flower. While this potential is acquired in flight, little is known of its origin or role in bee foraging behavior. However, we have conclusively shown that altitude of the hive and hence flight altitude plays a major role. Potentials on bees returning to the hive at the high altitude (5m) were 3 times greater than that on bees returning to a hive at 1 meter above the ground. These findings will undoubtedly play a major role in the development of a further understanding of bee-flower interactions (e.g. flowers on decumbent plants vs. tree flowers).

Technique Developed to Permit Collection of Floral Aromas in Field - Madison, Wisconsin. A major obstacle to the study of field produced floral aromas has been the inability to capture those volatiles in the field and store them for later laboratory analysis. We have developed and assembled the needed equipment to make this possible. These methods will greatly accelerate the study of floral aromas in situ.

Technological Objective 4: Identify and study biology of wild (non-Apis) bee pollinators and improve methods of using wild bees for crop pollination.

Research Locations:

Logan, Utah

Examples of Recent Progress:

Non-Apis Pollination of Apples Successfully Tested - Logan, Utah. Osmia lignaria bees were used to pollinate a 6 acre apple-pear orchard. Red Delicious apples and 2 varieties of pear had the highest yields ever obtained in the 16 years of production. Previously, this orchard had been pollinated by honey bees.

Non-Apis Pollinators of Sunflowers very Efficient. Wild bees were more efficient pollinators of male sterile sunflowers than honey bees. Sunflower pollinated by female Melissodes and Andrean set 11.6 and 4.4 times as many seeds/bee visit as did similar flowers pollinated by honey bees.



Technological Objective 5: Improve honey bee breeding and rearing knowledge of bee genetics and germplasm maintenance.

Research Locations:

Baton Rouge, Louisiana

Examples of Recent Progress:

Liquid Nitrogen Storage Impairs Viability of Honey Bee Sperm - Baton Rouge, Louisiana. Honey bee sperms stored in liquid nitrogen ( $-320^{\circ}\text{F}$ ) and later used to inseminate queens were the cause of eggs not hatching. These sperm cells were motile and biologically active (they entered eggs) yet they were nonviable. Immotile and completely viable sperms occurred in the same frozen samples. Nonhatching eggs or early abortions have not heretofore been reported from any other animal sperm stored in liquid nitrogen. However, such a phenomenon may also exist in the frozen sperm of other animals. It just happens to be much easier to detect in honey bees.

Rate of Sperm Depletion in a Queen Honey Bee Determined - Baton Rouge, Louisiana. Studies showed that the sperm depletion in a queen honey bee was logarithmic in that a queen gradually releases fewer sperms per egg as time passes. A general formula for sperm depletion was developed. Predicting how queens deplete the supply of sperms that they get during insemination will enable a bee breeder to predict how many sperms a queen needs in order to produce the desired number of fertilized eggs.

## P U B L I C A T I O N S

### Tucson, Arizona

- Gilliam, M. 1979. Microbiology of pollen and bee bread: the yeasts. *Apidologie* 10(1):43-53.
- Gilliam, M., S. Taber, III and R. J. Argauer. 1979. Degradation of Terramycin in honey. *Am. Bee J.* 119(10):720, 722, 723.
- Gilliam, M. 1979. Microbiology of pollen and bee bread: the genus Bacillus. *Apidologie* 10(3):269-274.
- Gilliam, M., S. Taber, III and R. J. Argauer. 1979. Degradation of oxytetracycline in sugar syrup and honey stored by honeybee colonies. *Journ. Apic. Res.* 18(3):208-211.
- Gilliam, M. 1979. Le couvain platre. *Sante de l'Abeille* 54(6): 179-183.
- Kauffeld, N. M., J. Nelson, and F. Harper. 1979. Honey bee preference for gynoeceious and monoecious pickling cucumbers. *In Proc. IV Int. Symp. on Poll. MD. Agric. Exp. Sta. Spec. Misc. Publ.* 1:177-182.
- Moffett, J. O. 1979. Techniques to reduce honey bee losses from insecticides. *Okla. Agric. Chem. Conf.* 4:16-21.
- Moffett, J. O., W. T. Wilson, A. Stoner, and A. Wardecker. 1979. Effect of fifteen combinations of four management methods on losses of honey bees caused by spraying insecticides on cotton. *J. Econ. Entomol.* 72:453-455.
- Moffett, J. O., A. Stoner, and A. Wardecker. 1979. Effect of two-queen colonies, Wardecker Waterers, and feeding pollen on winter honey production in Southwest Arizona. *Am. Bee J.* 119:776-777.
- Moffett, J. O., L. S. Stith, and C. W. Shipman. 1979. The use of bees to produce hybrid cotton seed. *Proc. West. Cotton Prod. Conf.* pp. 65-69.
- Moffett, J. O., L. S. Stith, and C. W. Shipman. 1979. Honey bees and the production of hybrid cotton seed. *Am. Bee J.* 119:492-493, 542.
- Moffett, J. O., L. S. Stith, and C. W. Shipman. 1979. The use of bees to produce hybrid cotton seed on male-sterile plants. *In Proc. IV Int. Symp. on Poll. MD. Agric. Exp. Sta. Spec. Misc. Publ.* 1:91-97.
- Moffett, J. O. and D. R. Rodney. 1979. Pollination requirements of Fremonts, Fairchild's. *Citrograph* 64:243, 252.
- Moffett, J. O., D. R. Rodney, and C. W. Shipman. 1979. Effect of hand pollination with nine citrus cultivars on yields of *Minneola tangelo*. *J. Ariz.-Nev. Acad. Sci.* 14:47-49.
- Slobodchikoff, C. N. and H. G. Spangler. 1979. Two types of sound production in Eupsophulus castaneus (Coleoptera:Tenebrionidae). *Coleopterists Bulletin* 33(2):239-243.

Spangler, H. G. and J. O. Moffett. 1979. Pollination of melons in greenhouses. Glean. Bee Culture 107:17-18

Spangler, H. G., N. M. Kauffeld, and C. D. Owens. 1978. Retrieval of greater wax moth larvae from combs of honey bees. Apiacta XIII (4): 167-169.

Stoner, A., J. O. Moffett, and A. Wardecker. 1979. The effects of the Todd dead bee trap, used alone and in combination with the Wardecker Waterer, on colonies of honey bees (Hymenoptera: Apidae). J. Kans. Entomol. Soc. 52:556-560.

Stoner, A., J. O. Moffett, A. Wardecker, and H. A. Rhodes. 1979. Benefit of the Wardecker Waterer to colonies of honey bees during stress and nonstress situations. Environ. Entomol. 8:418-420.

Waller, G. D. and R. J. Barker. 1979. Effects of dimethoate on honey bee colonies. J. Econ. Entomol. 72(4):549-551.

Waller, G. D., R. J. Barker and J. H. Martin. 1979. Effects of dimethoate on honey bee foraging. Chemosphere 7:461-463.

#### Baton Rouge, Louisiana

Blum, M. S., H. M. Fales, K. W. Tucker, and A. M. Collins. 1978. Chemistry of the sting apparatus of the worker honeybee. J. Apic. Res. 17(4):218-221.

Collins, A. M. 1979. Genetics of the response to an alarm chemical, isopentyl acetate, by the honeybee. J. Apic. Res. 18(4).

Harbo, J. R. 1979. Egg hatch of honey bees fertilized with frozen spermatozoa. Ann. Entomol. Soc. Am. 72(4):516-518.

Harbo, J. R. 1979. Storage of honeybee spermatozoa at -196°C. J. Apic. Res. 18(1):57-63.

Harbo, J. R. 1979. The rate of depletion of spermatozoa in the queen honeybee spermatheca. J. Apic. Res. 18(3):204-207.

Lackett, J. J. 1979. Effects of visits by honey bees Apis mellifera on production and quality of 'Dabreak' and 'Tangi' strawberry cultivars Fragaria x ananassa Duch. Md. Ag. Exp. Special Misc. Pub. No. 1, pp 137-142 (Proc. IVth International Pollination Symposium).

Nielsen, R. A. and C. D. Brister. 1979. Greater wax moth: Behavior of larvae. Ann. Entomol. Soc. Am. 72:811-815.

Rinderer, T. E. and J. R. Baxter. 1979. Honey bee hoarding behaviour: effects of previous stimulation by empty comb. Anim. Behav. 27(2): 426-428.

Rinderer, T. E. and J. R. Baxter. 1978. Effect of empty comb on hoarding behavior and honey production of the honey bee. J. Econ. Entomol. 71:757-759.

Rinderer, T. E., J. R. Baxter, C. E. Carter, Jr., and L. R. Mornhinveg. 1979. Empty comb stimulates honey production. Am. Bee J. 119:40-43.

Sylvester, H. A. 1979. The effects of lactose and galactose on bees caged with comb pieces. Am. Bee J. 119(5): 378.

Sylvester, H. A. 1979. Honey bees: Response to galactose and lactose incorporated into sucrose syrup. J. Econ. Entomol. 72(1):81-82.

Sylvester, H. A. and T. E. Rinderer. 1978. Assessing longevity, hoarding behavior, and response to Nosema in honey bees. Am. Bee J. 118(12):806, 807.

Tucker, K. W. 1980. Tolerance to carbaryl in honey bees increased by selection. Am. Bee J. 120:26-37, 39-41, 46.

Whatley, B. T. and J. J. Lockett. 1979. Effects of honey bee pollination on fruit set, yield, and quality of rabbiteye blueberries, Vaccinium ashei Reade. Md. Ag. Exp. Special Misc. Pub. No. 1, pp 143-148. (Proc. IVth International Pollination Symposium).

#### Beltsville, Maryland

Cantwell, G. E. 1979. The effect of disease on the bee's foraging and pollinating activities. Proc. IV International Symposium on Pollination. College Park, MD. 381-384.

Cantwell, G. E. and T. Lehnert. 1979. Lack of effect of certain microbial insecticides on the honeybee. J. Invertebr. Pathol. 33:381-382.

Cantwell, G. E. and T. Lehnert. 1979. Microbial control of the greater wax moth on stored comb. Am. Bee J. 119(3):200-201.

Hefetz, A., S. W. T. Batra and M. S. Blum. 1979. Chemistry of the mandibular gland secretion of the Indian bee Pithitis smaragdula. J. Chem. Ecol. 5(5):753-758.

Hefetz, A. and S. W. T. Batra. 1979. Chemistry of the cephalic secretion of Sceliphron caementarium. Experientia 35:1138.

Herbert, E. W., Jr. and H. Shimanuki. 1979. Honey bee nutritional studies at the Beltsville Bee Laboratory. Am. Bee J. 119(1):29-31, 43.

Herbert, E. W., Jr. 1979. Brood rearing by small caged honeybee colonies fed whey-yeast pollen substitutes. J. Apic. Res. 18(1):43-46.

Herbert, E. W., Jr. 1979. A new ash mixture of honeybees maintained on a synthetic diet. J. Apic. Res. 18(2):144-147.



Herbert, E. W., Jr and H. Shimanuki. 1979. Seasonal protein preferences of free flying colonies of honey bees. Am. Bee J. 119(4):298-302.

Herbert, E. W., Jr., H. Shimanuki and B. S. Shasha. 1979. Encapsulation of pollen attractants for honey bee diets. J. New York Entomol. Soc. 86(4).

Lehnert, T. and H. Shimanuki. 1979. Population change and Nosema spore levels in colonies started with package bees. Apidologie 10(1):17-21.

#### Logan, Utah

Arnett, W. H. 1980. Report on Chalkbrood, 11th annual "Interstate Alfalfa Seed Growers School." University of Idaho, Boise, Idaho. Ext. Serv. pamphlet (no identifying numbers).

Asensio, E. 1979. Report on alfalfa pollination studies in Spain. Proc. 4th Int. Sym. Pollination. Md. Agric. Exp. Sta. Spec. Misc. publ. 1:103-107.

Johansen, C. 1980. Report on Chalkbrood, 11th annual "Interstate Alfalfa Seed Growers School." University of Idaho, Boise, Idaho. Ext. Serv. pamphlet (no identifying numbers).

Kish, L. 1980. Report on Chalkbrood. 11th annual "Interstate Alfalfa Seed Growers School". University of Idaho, Boise, Idaho. Ext. Serv. pamphlet (no identifying numbers).

Parker, F. D. 1980. Nests of Osmia marginipennis Cresson with a description of the female (Hymenoptera: Megachilidae). Pan-Pacific Entomologist Vol. 56, No. 1, pp. 38-42.

Rashad, S. E., M. A. Ewies, and H. G. El Rabie. 1979. Pollinators of peanut and the effect of honey bees on its yield. Proc. 4th Int. Sym. Pollination. Md. Agric. Exp. Sta. Spec. Misc. Publ. 1:227-230.

Rashad, S. E., M. I. Mohamed and A. M. El Hefny. 1979. Some notes on the biology and behavior of Nomia unidentata Oliver. Proc. 4th Int. Symp. Pollination. Md. Agric. Exp. Sta. Spec. Misc. publ. 1:313-319.

Rashad, S. E., M. A. Ewies and H. G. El Rabie. 1979. Insect pollinators of sesame with special reference to the role of honey bees. Proc. 4th Int. Sym. Pollination. Md. Agric. Exp. Sta. Spec. Misc. publ. 1:231-234.

Stephen, W. P. 1980. Report on Chalkbrood, 11th annual "Interstate Alfalfa Seed Growers School." University of Idaho, Boise, Idaho. Ext. Serv. pamphlet (no identifying numbers).

Tepedino, V. J. 1979. Bee visitation of Phlox bryoides (Polemoniaceae). Great Basin Naturalist 39:197-198.

Tepedino, V. J. 1979. Notes on the flower-visiting habits of Pseudomasaris vespoides (Hymenoptera: Masaridae). Southwestern Naturalist 24:380-381.

Tepedino, V. J., J. M. Loar and N. L. Stanton. 1979. Experimental trapnesting: Notes on nest recognition in three species of megachilid bees. Pan-Pacific Entomologist 55:195-198.

Tepedino, V. J. and M. S. Boyce. 1979. A nest of Osmia tanneri Sandhouse from Wyoming (Hymenoptera: Megachilidae). Pan-Pacific Entomologist 55:234.

Tepedino, V. J. 1979. The importance of bees and other insect pollinators in maintaining floral species composition. Great Basin Nat. Mem. 3:139-150.

Tepedino, V. J., L. L. McDonald and R. Rothwell. 1980. Defense against parasitization in mud-nesting Hymenoptera: Can empty cells increase net reproductive output? Behavioral Ecology and Sociobiology 6:99-104.

Youseff, N. 1980. Report on Chalkbrood, 11th annual "Interstate Alfalfa Seed Growers School", University of Idaho, Boise, Idaho. Ext. Serv. pamphlet (no identifying numbers).

#### Madison, Wisconsin

Detroy, B. F., L. O. Whitefoot, and G. M. Hyde. 1979. Electrically heated uncapping knife and control. Transactions of the ASAE 22(4):886-888.

Erickson, E. H. and Ruth Medenwald. 1979. Parasitism of queen honey bee pupae by Melittobia acasta. J. Apic. Res. 18(1):73-76.

Erickson, E. H., R. W. Thorp and D. L. Briggs. 1979. Characterization of floral nectars by high-performance liquid chromatography. J. Apic. Res. 18(2):148-152.

Erickson, E. H. and M. B. Garment. 1979. Soya-bean flowers: nectary ultrastructure, nectar guides, and orientation on the flower by foraging honey bees. J. Apic. Res. 18(1):3-11.

Erickson, E. H., C. E. Peterson, and Patricia Werner. 1979. Honey bee foraging and resultant seed set among male-fertile and cytoplasmically male-sterile carrot inbreds and hybrid seed parents. J. Amer. Soc. Hort. Sci. 104(5):635-638.

Erickson, E. H. and C. E. Peterson. 1979. Asynchrony of floral events and other differences in pollinator foraging stimuli between fertile and male-sterile carrot inbreds. J. Amer. Soc. Hort. Sci. 104(5):639-643.

Erickson, E. H. and J. M. Robins. 1979. Honey from soybeans: the influence of soil conditions. Am. Bee J. 119(6):444-450.

Erickson, E. H. and C. E. Peterson. 1979. Problems encountered in the pollination of cytoplasmically male-sterile hybrid carrot seed parents. IVth Int. Symp. Poll. Proc. pp 59-63.

Erickson, E. H. 1979. The status of hybrid soybeans. IVth Int. Symp. Poll. Proc. 1:25-28.

Moeller, F. E. 1979. How long must honey bees be present to effectively set a crop of cranberries. IVth Int. Poll. Symp. Proc. pp. 171-174.

Owens, C. D. and B. F. Detroy. 1979. Selecting and operating commercial beekeeping equipment. USDA SEA Farmers' Bul. No. 2267, 23 pp.

#### Laramie, Wyoming

Hitchcock, J. D., A. Stoner, W. T. Wilson, and D. M. Menapace. 1979. Pathogenicity of Bacillus pulvifaciens to honey bee larvae of various ages. J. Kans. Entomol. Soc. 52(2):238-246.

Menapace, Diana M. and William T. Wilson. 1979. Feeding Oxytetracyclines as Terramycin does not aggravate chalkbrood infections. Apidologie 10(2):167-174.

Moffett, J. O., W. T. Wilson, A. Stoner and A. Wardecker. 1979. Effect of 15 combinations of four management methods on losses of honey bees caused by spraying insecticides on cotton. J. Econ. Entomol. 72:453-455.

Moffett, J. O., A. Stoner and A. L. Wardecker. 1979. Effect of two-queen colonies, Wardecker waterers, and feeding pollen on winter honey production in Southwest Arizona. Am. Bee J. 119:776-777.

Rhodes, H. A., W. T. Wilson, P. E. Sonnet, and A. Stoner. 1979. Exposure of Apis mellifera to bee-collected pollen containing residues of microencapsulated methyl parathion. Environ. Entomol. 8(5):944-948.

Sonnet, Philip E. 1979. Insecticides--Plus! Bee World 60(2):57-58.

Stoner, A., J. O. Moffett, A. L. Wardecker, and H. A. Rhodes. 1979. Benefit of the Wardecker waterer to colonies of honey bees during stress and nonstress situations. Environ. Entomol. 8:418-420.

Stoner, A., J. O. Moffett and A. L. Wardecker. 1979. The effect of the Todd dead bee trap, used alone and in combination with the Wardecker waterer, on colonies of honey bees. J. Kans. Entomol. Soc. 52:556-560.

Stoner, A., H. A. Rhodes and W. T. Wilson. 1979. Case histories of the effects of microencapsulated methyl parathion (Pennkap-M) applied to fields near honey bee colonies. Am. Bee J. 119:648-654.

Stoner, A., H. A. Rhodes, W. T. Wilson and R. R. Sackett. 1979. Honey bees, sunflowers, and methyl parathion-malathion spray in central Wyoming. Am. Bee J. 119:774-775, and 784.

Wilson, William T. and Diana M. Menapace. 1979. Disappearing disease of honey bees: a survey of the United States. Am. Bee J. 119 (2 and 3): 118-119, 184-186, and 217. (Two parts).

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## National Research Program 20190

### IMPROVED METHODS AND EQUIPMENT FOR PRODUCTION OF FIELD,

### HORTICULTURAL, AND FIBER CROPS

Technological Objective 1:            Develop improved equipment for harvesting crops to reduce field losses, improve quality, and reduce labor and machinery costs.

The cost of production and the field losses resulting from present methods of harvesting continue to be a concern of both growers and consumers. The purpose of this program is to develop new or improve existing harvesting equipment which can reduce these costs and losses while maintaining acceptable quality of the resulting commodities. The improved equipment may reduce field losses, improve the product quality, or reduce labor and machinery costs, depending on the particular crop involved and the technological opportunities available.

NPS Contact: L. A. Liljedahl

#### Research Locations:

Albany, California  
Salinas, California  
Belle Glade, Florida  
Lake Alfred, Florida  
Urbana, Illinois  
East Lansing, Michigan  
Stoneville, Mississippi  
Lubbock, Texas  
Suffolk, Virginia  
Wenatchee, Washington  
Kearneysville, West Virginia

#### Examples of Recent Progress:

A semi-automatic film wrapper for lettuce was developed to improve product quality and reduce labor - Salinas, California. The machine holds the film on the edges by belts. As these belts converge a trough is formed into which the heads are placed by hand. The two top edges of the trough are then brought together over the top of the head. The film is cut above and on both sides of the head and the two sides of the trough are sealed together forming a pouch type of package. A reliable method of carrying the film has been developed and work is presently continuing on the development of a faster method of sealing the film and an electronic control for the sealer. This sealer is relatively simple, is not sensitive to the size of objects being wrapped, and does not require irregularly shaped objects to be placed on uniform trays before they are wrapped.

Principles for mechanically harvesting and cleaning chili peppers have been developed - Salinas, California. Finger belts for picking the peppers have been developed and evaluated. They will presently remove 98-99% of the peppers from the plants and put approximately 80% onto a conveyor. The remaining 20% fall onto the ground. Components for picking up and cleaning peppers which fall on the ground before and during harvest were developed and evaluated. The pickup apparatus was substantially improved and picked up approximately 65% of the peppers on the ground. The cleaning apparatus did an acceptable job but substantial improvement is still possible. No differences in rodent hair, insect fragment, and sand content were found between mechanically harvested and hand harvested peppers. All industry observers felt the mechanically harvested peppers had less trash than those which were hand harvested.

Energy requirements for mechanically harvesting burned and unburned sugarcane have been determined - Belle Glade, Florida. Two experiments have been completed involving time-motion studies on a total of 30 acres yielding about 1250 tons of sugarcane. Harvester fuel consumption per net of ton sugarcane was 43 percent higher in unburned cane than in burned cane. Transport fuel consumption was 9 percent higher in unburned cane than in burned cane. Harvesting losses were about 3.1 tons per acre higher in unburned cane than in burned cane. Power usage by different components and harvesting pour rates was also determined in burned and unburned cane. Considerable amounts of additional power were found necessary during peak loads of cane.

Equipment developed for ground pick-up of citrus fruit - Lake Alfred, Florida. Equipment was designed and built which demonstrated that citrus fruit dropped to the ground by mass removal methods can be satisfactorily retrieved mechanically by windrowing, picking up, cleaning, and conveying to a transport unit, all with minimum losses or fruit damage. Fruit recovery has been above 98% in tests to date. Success with these experimental systems insures that mechanical harvesting is a viable alternative to arduous manual pick-up, and provides guidelines for orderly transition to increased mechanization in Florida citrus groves as economic conditions mandate.

A mechanical harvester for bunched fresh market leafy vegetables was developed and tested - E. Lansing, Michigan. An experimental one-row harvester and buncher was constructed and field tested. Mustard and turnip greens were harvested at 430 to 700 bunches/hr (ground speed of 5 m/min) and were more uniform in size (340 g) and appearance than hand harvested bunches. Hand harvesters average 130 bunches/hr. Drill-planted collards also worked well if plant height did not exceed 45 cm. A self-guiding 2-row harvester may increase worker productivity by 3 times and be appropriate for the typical midwest grower. Green onions were also harvested and bunched. This equipment has considerable potential for easing the labor shortage and the problem of high harvest costs now faced by family farm vegetable growers in the midwest.

A continuously moving harvester developed for peaches was demonstrated to have potential for cherry harvest in Michigan - E. Lansing, Michigan. A field test and demonstration were conducted at Traverse City, Michigan, in

a block of 12 year-old trees of the type compatible with the harvester. The automatic trunk shaker was very effective and did not cause bark damage. Fruit quality was the same as for other shake-catch equipment. The harvester operated at 150 to 180 trees/hr. Time study results suggest that 240 trees/hr should be attainable with changes in the design to adapt it to Michigan tart cherries. The Michigan cherry industry has been looking for a harvesting system which is compatible with the new production system they are developing which uses smaller trees planted at 750 to 1500 per hectare.

Automatic guidance system developed for over-the-row power frame harvesters was developed and tested - E. Lansing, Michigan. An automatic guidance system for a fruit harvester, using tree contact, was designed, constructed, and tested using simulated field conditions. Harvester positioning over trees in the harvester appears satisfactory. Accurate alignment of trees entering the harvester is required, and this is presently difficult to accomplish visually.

Mechanical pepper harvester entering commercial usage - E. Lansing, Michigan. The mechanical pepper harvesting concept originated by the University of Georgia and developed by this unit has been incorporated in 14 harvesters built in the U.S. in a 2-year period. Eight of those have been built by three commercial manufacturers. The remaining six were built by growers or processors. Continued labor availability problems indicate a likely increase in the adoption of pepper harvest mechanization.

Stripper harvesting of cotton tested in Midsouth - Stoneville, Mississippi. The harvesting efficiency and cost reducing potential of brush-roll and finger strippers was compared with the conventional spindle picker for harvesting six varieties of cotton that have different plant characteristics. Generally, cotton harvested with the picker yielded more lint/A than the plots harvested with the brush-roll stripper. Samples from the picker cotton were higher in quality than samples from the stripper cotton. The effect of varietal characteristics was apparent in the picker-harvested cotton with respect to yield, earliness, percent lint turnout, color, and length uniformity. Cotton yields ranged from a high of 1028 lb. lint/A (DPL-nectariless okra leaf) to a low of 726 lb. lint/A (DPL-16 and Stoneville 213). Earliness, expressed as % of total yield obtained at first harvest, ranged from 77% (Stoneville 7A nectariless okra leaf) to 46% (DPL-61). The stripper-harvested cotton, although lower in yield, had good fiber properties. The stripper yield reduction was primarily due to the comparison of a once-over stripper harvest to a twice-over picker harvest in high yielding cotton.

Five experimental chemicals continue to show potential for accelerating boll opening - Stoneville, Mississippi. For the second year, the chemicals DEF, GAF-141, ethrel, arsenic acid, and paraquat were applied to conventionally grown DES-56 cotton to evaluate their effect on the rate of boll opening. These chemicals were applied alone and in various combinations and the results compared to an untreated control. The effect of chemical treatments was apparent at first harvest with 10 treatments resulting in an average of 92.1 percent of the total harvested yield as compared to only 75.6 percent from the untreated control. Only one chemical treatment, DEF plus paraquat, resulted in a significantly lower yield than the total yield of the untreated control.



Eighty percent labor reduction achieved with machine harvesting of apples - Wenatchee, Washington. Machine harvesting time was 2.90 man-min. per hundredweight. Average hand picking time in the area is 14.12 man-min. per hundredweight. Packout of extra fancy and fancy machine harvested fruit was 24% less than for hand harvesting.

Technological Objective 2:                      Develop improved equipment and techniques for farm handling, cleaning, drying, and processing of harvested crops to improve quality and reduce costs of labor and machinery.

NPS Contact:    L. A. Liljedahl

Research Locations:

Tifton, Georgia  
E. Lansing, Michigan  
Corvallis, Oregon  
Wenatchee, Washington

Examples of Recent Progress:

Water handling bulk storage of apples investigated - E. Lansing, Michigan. A 2400 bu bulk storage using water for conveying, filling, and emptying was installed and operated on a family farm. The storage was used for short-term holding of apples used for their cider mill operation. The handling and storage system functioned very well.

Improved seed separator developed - Corvallis, Oregon. A new design of special indent cylinder separator eliminates the problem of seed plugging in the indents. The self-cleaning machine uses a belt and a rotating brush. The belt contacts the lower portion of the cylinder where the separation is occurring and then is held away from the top portion far enough to allow room for the cleaning brush to clean the indents. Elimination of seed plugging in this cylinder can lead to a more effective length separator for seed processors.

New space saving fruit accumulator - Wenatchee, Washington. A new method has been developed for accumulating presorted and presized fruit that is to be replaced into bins for storage and subsequent packing. The potential savings in floor space (up to 50%) will be beneficial for both new installation and to many existing packinghouses that may wish to convert to the newer methods of presorting and presizing.

Technological Objective 3:                      Develop improved equipment and techniques for tilling, planting, transplanting, fertilizing, and cultivating crops to increase production, reduce labor and machinery costs, reduce fossil fuel use, and improve harvesting efficiency.



NPS Contact: L. A. Liljedahl

Research Locations:

Salinas, California  
Shafter, California  
Belle Glade, Florida  
Urbana, Illinois  
Beltsville, Maryland  
East Lansing, Michigan  
Mississippi State, Mississippi  
Stoneville, Mississippi  
Lubbock, Texas  
Temple, Texas  
Suffolk, Virginia

Examples of Recent Progress:

Higher speed operation of punch planter device for vegetable seeds investigated - Salinas, California. It was determined that the maximum punch planter speed is strongly dependent on the magnetic attraction of the coated seeds to the magnetic punch. The magnetic attraction of the coated seeds was measured for several different concentrations of iron and iron oxide. It was found that the attraction force was less for the iron oxide than for the iron and also varied according to the company performing the coating operation.

Weeds controlled by automatically steered cultivation - Shafter, California. Efficiency of mechanical weed control was improved by 24% and speed of operation increased by 300% by use of tractor guidance system without a decrease in crop stand. Operation at speeds up to 10 km/hr were found to be practical. The second year test of soil-driven herbicide incorporation cotton planter indicated that performance can be expected to be lower without rainfall; however, the mechanism has superior performance as a cotton planter in all conditions tested. Control of weeds in 51 cm rows was found to be comparable to 102 cm rows for herbicides but lower for mechanical cultivation. Narrow single beds were found to be practical for irrigation, planting, and cultivating when 100 meters long but longer rows need to be evaluated.

Further development of mechanical sugarcane planting - Belle Glade, Florida. Mechanical planter development for cane was continued with two field tests involving 3.2 acres where application rates of seed material was measured. The application rate in one test was 5.12 tons per acre where the hand planting rate was 4.36 tons per acre. The second test achieved an application rate of 4.27 tons per acre, which was less than the rate by hand. Although seed material application rate is an approximate indication of machine planter performance, yields of sugarcane from mechanical and hand planted experiments remain to be compared.

Improved planting equipment increases soybean yields - Urbana, Illinois. A three year study using a grain drill equipped with depth bands and pulled behind a culti-mulcher has proved that adequate equipment is now available for producing soybeans in narrow (18 to 38 cm) rows in conventionally tilled seedbeds. The results verify that with good management practices and with the correct variety selection, yield increases of 10 to 20 percent can be obtained in 18 cm rows as compared to 76 cm rows.

Microprocessor controlled bypass spray equipment improves accuracy of pesticide application - Urbana, Illinois. A variable-rate pesticide spraying system utilizing bypass nozzles has been developed that can deliver spray solutions over a six-fold range of flow rates without significant degradation of the spray characteristics. A microprocessor-based soil organic matter sensing system was designed and tested in the laboratory. When these two systems are joined in a field crop sprayer, the pesticide application rate can be automatically controlled by the microprocessor according to soil organic matter content and the sprayer ground speed. This technique could reduce pesticide injury of soybean plants and improve pest control.

Wheelbarrow fertilizer for nursery and row crops - Beltsville, Maryland. A hand operated fertilizer applicator was developed for side dressing nursery and row crops. This unit fills a need of nurseries and small area growers as commercial units are not available. This equipment can be assembled by the user from available commercial components in farm or ranch shops.

A new type of pruner-chipper for shaping fruit trees has been designed and evaluated - E. Lansing, Michigan. A modified heavy screw-conveyor was tested on Red Delicious and Jonathan apples, and Redhaven peaches. The screw-conveyor removed 80 percent of the vertical and 60 percent of the horizontal growing fruit wood. These results indicate that this device may be a promising approach to shaping of trees.

USDA fruit tree planter entering commercial use - E. Lansing, Michigan. The continuous tree planter developed by the USDA is finding wider acceptance in the fruit industry. Over 450 commercial units are now in use from coast to coast.

Deep tillage may waste energy - Mississippi State, Mississippi. Deep tillage on medium to heavy soils may not be necessary every year to maintain cotton and soybean yields, especially if tractor-wheel traffic is controlled. While deep subsoiling has not increased yield on silty clay loam in this 4-year study, controlled traffic preserved some of the effects of subsoiling for 3 years. This may be an important consideration in soils that have only moderate compaction problems. Since tillage accounts for the largest expenditure of energy in agricultural production and since subsoiling is the most energy-consuming of all tillage operations used in this area, farmers should be aware that it may not be beneficial every year on some soils.

Sprayer for applying herbicides under combine straw - Mississippi State, Mississippi. A grain combine-attached sprayer was developed to apply herbicides under straw in a double-cropping system where soybeans are planted following wheat in the spring. Liquid pre-emergence herbicides are sprayed onto the ground in the short stubble left by the combine ahead of the straw chopper. Following the straw chopper the herbicide is incorporated into the soil with a rolling cultivator with the tines turned backwards so that they are self-cleaning. Soybeans were planted with a no-till planter. Weed control and yield was better following this system than following conventional incorporation with a disk harrow. This technique offers an alternative to the standard practice of burning straw and using conventional seedbed preparation methods which contribute to pollution and soil moisture loss.

Cotton lint development model formulated - Lubbock, Texas. A mathematical model of the development of cotton lint has been formulated and tested against field data for several years. The model has the relative rate of increase of lint cotton weight as the dependent variable; temperature and final lint weight are the dependent variables. A procedure for estimating elapsed potential in real time has also been added and is under field test.

Stages of cotton boll development characterized - Lubbock, Texas. Tentative characteristics of 8 stages of boll development, from first bloom to boll set, have been described. Length of time to reach various levels of boll development has been measured in field experiments and shown to be fairly consistent.

Development of prototype direct peanut harvester - Suffolk, Virginia. Peanuts harvested with the direct harvester are damaged less during harvesting and are not subjected to adverse weather in the windrow. Additional drying cost is required as compared to conventionally harvested peanuts; however, dryers can be managed throughout the peanut moisture removal process. The picking principle employed in the USDA one-row machine has been incorporated into a two-row prototype machine developed at Clemson University. The machine has been field operated in South Carolina and Virginia. The workability and visibility of this method of peanut harvesting has been demonstrated to the peanut producer. The success of this project was made possible through the cooperative efforts of the Agricultural Engineering Department, Clemson University, a peanut producer in Aiken, South Carolina, and USDA-SEA, Suffolk, Virginia.

Development of a microprocessor based peanut dryer control system - Suffolk, Virginia. Additional software was developed for a microprocessor-based data acquisition system to provide fundamental peanut dryer control functions. The following functions were included: (1) burner control; plenum air temperature high limit and maximum wet bulb depression limit, (2) fan control; ambient air temperature low limit and time based cycling, and (3) data acquisition; periodically print and punch dryer performance data. The system was interfaced to an existing peanut sample dryer and successfully operated in 1979. This system represents the first step toward complete computer control and optimization of the peanut drying process. Energy optimization from the control standpoint can now be easily introduced through software enhancements.

Technological Objective 4:                      Develop equipment, facilities, and techniques to control or modify crop environment in the field, plant growth chambers, and in greenhouses.

NPS Contact: L. A. Liljedahl

Research Location:

Beltsville, Maryland



### Example of Recent Progress:

Light sources for supplementing natural winter light in greenhouses - Beltsville, Maryland. Most vision light sources can be used to create a near optimum growing environment. High pressure sodium (HPS) and low pressure sodium (LPS) are the most efficient sources currently available when evaluated on a basis of irradiance per input watt. Plant response is mainly dependent on irradiance W/m (400-850 nm). Plant requirements vary from 10 to 40 W/m<sup>2</sup>. HPS and LPS can extend the optimum greenhouse growing conditions thru the winter months.

## P U B L I C A T I O N S

### Belle Glade, Florida

Clayton, J. E. and Eiland, B. R. 1979. "Concepts and Current Research for Florida Biomass Production," Proceedings, Biomass Mechanization Workshop - Baton Rouge: 21-45.

Clayton, J. E., Eiland, B. R., Tai, P., and Miller, J. D. 1979. "Harvester Performance Efficiency in Florida Sugarcane Varieties Having Diverse Stalk Characteristics", Proceedings, Florida Division, American Society of Sugar Cane Technologists.

Eiland, B. R. and Dean, J. L. 1979 Increasing Yields from Mechanically Harvested Sugarcane Seedpieces. American Society of Sugar Cane Technologists.

### Urbana, Illinois

Hummel, J. W. and W. R. Nave. 1979. Impact cutting of soybean plants. Transactions of the ASAE, 22(1):35-39.

Nave, W. R. and M. R. Paulsen. 1979. Soybean seed quality as affected by planter meters. Transactions of the ASAE, 22(4):739-45.

Nave, W. R., D. L. Hoag, and J. W. Hummel. 1979. Sickie and guard design for soybean harvesting. Transactions of the ASAE, 22(1):3034.

Paulsen, M. R. and W. R. Nave. 1979. Five planter meters tested for damage to soybean seed. Illinois Research, 21(2):10-11.

Wendte, K. W. and W. R. Nave. 1979. Systems for interseeding and double cropping soybeans. Transactions of the ASAE, 22(4):719-23.

### Beltsville, Maryland

Brown, J. D., Cathey, H. M., Bennett, J. H. and Thimijan, R. W. 1979. Effect of light quality and temperature on  $FE^{3+}$  reduction, and chlorophyll concentration in plants. Agron. J. 71: 1051-1021.



Cathey, H. M., and Campbell, L. E. 1979. Relative efficiency of high-and low-pressure sodium and incandescent filament lamps used to supplement natural winter light in greenhouses. J. Amer. Soc. Hort. Sci. 104(6): 812-825.

Dudley, R. F. and Smith, F. F. 1980. 'Wheelbarrowing' fertilizer saves time and money. Southern Florist and Nurseryman.

#### E. Lansing, Michigan

Burton, C. L., R. C. Herner, and B. R. Tennes. 1979. Results of 1978 carrot postharvest decay trials. Fungicide and Nematicide, Vol. 33.

Burton, C. L., B. R. Tennes, G. K. Brown and Ann Hazelrigg. 1979. The effect of bruising on the percent pitted yield of tart cherries. Mich. Agr'l Expt. Sta. Rept. 377, May.

Burton, C. L., B. R. Tennes and G. K. Brown. 1979. Air Cooled Storage of Bulk Apples in a Silo--A Progress Report. Trans. of ASAE 22(3): 510-512.

Tennes, B. R. and C. L. Burton. 1979. A Rapid Planting Method for Fruit Trees and Bushes. Trans. of ASAE 22(4):699-701.

#### Mississippi State, Mississippi

Barker, G. L., R. W. McClendon, R. F. Colwick, and J. W. Jones. 1979. Relationship between cotton lint color and weather exposure. Trans. of ASAE 22(3):470-474.

Colwick, R. F., G. L. Barker, and S. W. Rayburn. 1979. Row spacing, short season and stripper harvesting of cotton in northeast Mississippi. Mississippi Agricultural and Forestry Experiment Station Technical Bulletin 94. 16pp.

Jones, J. W., R. F. Colwick, G. L. Barker, and R. W. McClendon. 1979. Optimum time for harvesting cotton: a new concept. Trans. of ASAE 22(2): 291-296.

Rousselle, Marie-Alice, Mary L. Nelson, Gary L. Barker, and Rex F. Colwick. 1979. Restoration of the never-dried fiber state. The Cotton Gin and Oil Mill Press, pp. 11, 15. December.

Simmons, J. G., J. P. Cherry, R. F. Colwick, G. L. Barker, R. A. Wesley, E. B. Hudspeth, J. W. Laird, and R. V. Baker. 1979. Unopen cotton boll harvesting--evaluation of cotton-seed quality. Beltwide Cotton Prod. Res. Conf. Proc., pp. 32-36.

#### Stoneville, Mississippi

Barrentine, W. L., Wooten, O. B., and Williford, J. R. 1979. Effect of incorporation methods and time of application on the performance of Trifluralin + Metribuzin. Weed Science. Vol. 27, No. 1, pp. 64-68.

Colwick, Rex F. 1979. Controlled-traffic, reduced-tillage research for cotton production in the United States. Proc. 8th Conf. of International Soil Tillage Research Organization, Univ. of Hohenheim, Germany, pp. 339-345.

Colwick, R. F. and G. L. Barker. 1979. Residual effects of subsoiling under a controlled traffic system in a silty-clay loam soil--third year results. Beltwide Cotton Prod. Res. Conf. Proc., pp. 108-109.

Hurst, Harold R., Williford, Ray, and Wooten, O. B. Redvine control in cotton. Proceedings, Cotton Production-Mechanization Conference. 1979. pp. 145-147.

Luckett, Kirk. Effect of Harvest-Aid Chemicals on Cotton Earliness and Yield. Proceedings of the 1979 Beltwide Cotton Production Research Conference, p. 114.

Williford, J. R. 1979. Subsoiling - residual study - third year. Proceedings, Cotton Production-Mechanization Conference. Pp 107-108.

#### Corvallis, Oregon

Park, J. K. 1979. A machine that separates rough from smooth seed. Transactions, American Society of Agricultural Engineers 22:989-991 and 996.

#### Lubbock, Texas

Bilbro, J. D., Wanjura, D. F., and Minton, E. B. 1979. Effects of premature plant kill and hand defoliation on cotton performance. Texas Agricultural Experiment Station MP-1436, 6 pp.

Minton, E. B., Wanjura, D. F., and Bilbro, J. D. 1979. Effects of premature defoliation and plant kill on germination of cottonseed. Agron. J. 71:659-661.

Simmons, J. G., Cherry, J. P., Colwick, R. F., Barker, G. L., Wesley, R. A. Hudspeth, E. B., Laird, J. W., and Baker, R. V. 1979. Unopen cotton boll harvesting--evaluation of cottonseed quality. Proc. Beltwide Cotton Production Research Conf. Phoenix, Arizona.

Wanjura, D. F., and Baker, R. V. 1979. Characteristics of sticks in mechanically stripped cotton. Trans. ASAE 22:233-237.

Wanjura, D. F., and Baker, R. V. 1979. Stick and bark relationship in the mechanical stripper harvesting and seedcotton cleaning system. Trans. ASAE 22:273-279.

Wanjura, D. F. 1979. Controlled fruiting in cotton. Texas Agricultural Experiment Station MP-1428, 6 pp.

Wanjura, D. F. 1979. Cotton yield response to plant spacing uniformity. Proc. Beltwide Cotton Prod. Mechanization Conf. p. 111. (Abstract)

Wanjura, D. F., Jones, J. W., and Hesketh, J. D. 1979. Field studies and model simulation of the first square event in cotton. Agron. J. 71:261-266.

Wanjura, D. F. 1979. Plant size influence on sticks in mechanically stripped cotton. Texas Agricultural Experiment Station MP-1414, 8 pp.

Suffolk, Virginia

Coffelt, T. A., F. S. Wright and J. L. Steele. 1979. New harvesting and curing techniques in the production of breeder's seed peanuts. Peanut Science 6(2):70-72.

Wright, F. S. and J. L. Steele. 1979. Potential for direct harvesting of peanuts. Peanut Science 6(1):37-42.

Wenatchee, Washington

Berlage, A. G. and R. D. Langmo. 1979. Shake harvesting tests with fresh-market apples. Trans. of the ASAE 22(4):733-738, 745.

NRP 20190 - IMPROVED METHODS AND EQUIPMENT FOR PRODUCTION OF FIELD,  
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Harold L. Brewer  
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Arnold G. Berlage  
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COM: 509-662-4336

KEARNEYSVILLE, WVA 25430  
Donald L. Peterson  
USDA Appalachian Fruit  
Research Station  
P.O. Box 179

COM: 304-725-3451



Special Research Program (under NRP 20160)

PRODUCTION AND CONTROL OF NARCOTIC PLANTS

This Special Research Program works to affect the production economics of illicit narcotic crops so as to give licit agricultural enterprises a competitive advantage and, secondly, assure that the United States has an adequate and stable supply of raw materials to meet its medical needs for codeine at reasonable cost.

NPS Contact: Quentin Jones

A separate Annual Report was not prepared this year.

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